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Introduction

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National Aeronautics and Space Administration

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Scientific and Technical Aerospace Reports

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01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N65-20190# Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (West Germany). Institut für Aerodynamik
INCREASE OF MAXIMUM LIFT OF A RECTANGULAR WING IN GROUND PROXIMITY BY COMBINED BLOWING AT THE LEADING EDGE AND AT THE NOSE OF THE FLAP [ERHOHUNG DES MAXIMALAUFTRIEBES EINES RECHTECKFLUGELS IN BODENNAHE DURCH KOMBINIERTES AUSBLASEN AN DER FLUGELNASE UND AN DER HINTERKANTENKLAPPE]
R. Löhr May 1964 39 p refs In GERMAN; ENGLISH and FRENCH summaries Sponsored by Deut. Forschungsgemeinschaft
(DLR-FB-64-02) Munich, ZLDI: 11,50 DM

Wind-tunnel measurements were carried out on a rectangular wing with trailing edge flap situated between end plates in ground proximity. To increase the maximum lift by boundary layer control, the wing was equipped with blowing slots at the leading edge and at the nose of the flap. The effectiveness of combined blowing at the leading edge and the nose of the flap with respect to lift increase was tested for a flap deflection of 60° with different ground distances. The results show that for a given quantity of blowing a greater increase of maximum lift can be produced when applying combined blowing than with blowing at the flap only. Author

N65-20310# France. Office National d'Etudes et de Recherches Aérospatiales, Chatillon-Sous-Bagneux.
A METHOD FOR THE INTERPRETATION OF MEASURES OF NON-STATIONARY PRESSURES [UNE METHODE POUR L'INTERPRETATION DES MESURES DE PRESSIONS INSTATIONNAIRES]
Roger Destuynder [1964] 21 p refs in FRENCH Presented at the 19th Reunion of the Mater. and Struct. Group of AGARD, Paris, 12–17 Oct. 1964

A semitheoretical, semiexperimental method permitting the calculation of nonstationary forces in subsonic flow using three-dimensional profiles is established. The object is to predict, beginning with some measurements of pressure on a wing in subsonic flow, the distribution of pressure on the whole wing; then to deduce the nonstationary aerodynamic forces corresponding to a given movement of the wing. This is accomplished by using a mathematical form adjustable by empirical coefficients. A short description of the equipment is given, and comments are made on some applications of the method. Trans. by M.P.G.

N65-20456# Naval Ordnance Lab., White Oak, Md.
ABRES RESEARCH—NOL BALLISTICS RANGE PROGRAM Quarterly Progress Report, 20 Oct. 1964–20 Jan. 1965
[1965] 23 p refs
(AD-455569)

The characteristics of the hyperballistics and the pressurized ballistics ranges are summarized. Determinations of the turbulent skin friction coefficient for a slender cone and of the effect of high heat transfer rates on the boundary layer transition are reported. Analytical and experimental results of the drag components for a slender cone, 6.3° cone, and 9° cone were reported. The contribution due to hypersonic turbulent skin friction varied from about 20% at Mach 7 to almost 30% at Mach 15. Tests to determine the effect of the temperature ratio of model wall temperature to recovery temperature on the stability of the laminar boundary layer are also reported. Tests at temperatures of 85° to 400° C gave ratios from 0.090 to 0.055. Although transition occurred on the model surface during Mach 8 at a temperature ratio of 0.09, in the previous tests the flow remained entirely laminar at the same temperature ratio at Mach 5. E.E.B.

N65-20490# Royal Aircraft Establishment, Farnborough (England).
A SIMPLE ESTIMATE OF THE PROFILE DRAG OF SWEPT WINGS
J. Weber and G. G. Brebner London, Min. of Supply, Jun. 1952 15 p refs
(RAE-TN-AERO-2168)

It is shown that the profile drag of swept wings near zero lift can be calculated much more simply than might be expected in view of the complicated nature of the three-dimensional boundary layer. Following the approach of Young and Booth, simple charts are derived for obtaining a drag reduction factor due to sweep. The profile drag of a swept wing may be obtained by applying this factor to the results of Squire and Young for two-dimensional airfoil, if the transition position on the swept wing is known. Results of such a calculation are confirmed by experimental data from a 45° sweptback wing of aspect ratio 3. Author

N65-20491# Royal Aircraft Establishment, Farnborough (England).
SOME REMARKS ON MULTHOPP'S SUBSONIC LIFTING SURFACE THEORY
K. W. Mangler and B. F. R. Spencer London, Min. of Supply, Aug. 1952 10 p refs
(RAE-TN-AERO-2181)

This note presents an alternative method to that proposed by Multhopp in his subsonic lifting surface theory for dealing with the spanwise integration of the downwash. The method replaces Multhopp's original approximate method for dealing with the logarithmic singularity in the integral by a more rigorous procedure. Multhopp's scheme for the solution of the system of linear equations is retained, and there is no increase in the amount of computer work involved. Author

N65-20493# Royal Aircraft Establishment, Farnborough (England).
SLENDER DELTA WINGS WITH SHARP EDGES AT ZERO LIFT
J. Weber London, Min. of Supply, May 1957 46 p refs
(RAE-TN-AERO-2508)

Several slender wings of delta planform with sharp edges were investigated theoretically at zero lift at subsonic and at supersonic speeds. Most of the wings have diamond-shaped cross sections and are intended to lead to a type of flow with leading-edge separation in the lifting condition. The pressure distributions and overall normal-pressure drags resulting from various theoretical methods are compared with one another, and some discussion is included concerning the possibility of achieving the results, calculated for an inviscid stream, in a real flow in the presence of a viscous layer around the body. Author

N65-20494# Royal Aircraft Establishment, Farnborough (England).
CALCULATION OF THE LOAD DISTRIBUTION OVER A WING WITH ARBITRARY CAMBER AND TWIST AT SONIC SPEED
K. W. Mangler London, Min. of Supply, Aug. 1954 54 p refs
(RAE-AERO-2515)

A method is developed for the calculation of the load distribution due to camber and twist over a thin wing at sonic speed (or, more generally, over wings for which $A^2|M^2-1|$ is small (A aspect ratio, M Mach number)). The calculation is based on the usual assumptions of linearized potential flow without friction and shock waves. Application of the method involves the solution of a given integral equation, which for a general planform has to be solved numerically. Some simple examples show the effect of twist and camber on the load distribution and on the suction force along the leading edge of a delta wing. Author

N65-20495# Royal Aircraft Establishment, Farnborough (England).
DESIGN OF WARPED SLENDER WINGS WITH THE ATTACHMENT LINE ALONG THE LEADING EDGE
J. Weber London, Min. of Supply, Sep. 1957 84 p refs
(RAE-TN-AERO-2530)

This note deals with the design of slender warped wings with unswept trailing edge but otherwise arbitrary planform which have, at the design lift coefficient, zero load along the leading edge and a near planar vortex sheet from the trailing edge. The wing can have an arbitrary chordwise curvature on which a spanwise curvature is superposed so that in any spanwise section the wing is straight over the inner part of the wing and curved over the portion near the leading edges: the position of this change can vary arbitrarily in the chordwise direction. Formulas and working charts are given for determining the local load coefficient (and with it the streamwise velocity component), the spanwise velocity component, the total lift coefficient, and the total drag. Author

N65-20496# Royal Aircraft Establishment, Farnborough (England).
THE SHAPE OF A WING HAVING ELLIPTIC SPANWISE LOADING AT M = 1.0
K. W. Newby London, Min. of Supply, Jun. 1958 40 p refs
(RAE-TN-AERO-2568)

Equations are given which enable the planform shape and mean-surface shape of a swept-back wing having elliptic spanwise loading and linear chordwise loading at M = 1.0 to be obtained. The downwash equations, from which the mean-surface shapes are derived can be applied to wings of arbitrary planform provided the lift per unit area varies linearly both in the chordwise direction, and along lines passing through the point of intersection of the tangents to the leading and trailing-edges at the center-line. Preliminary calculated results suggest that wings designed for M = 1.0 will not differ significantly from wings designed to have the same loading at low supersonic Mach numbers, and that elliptically loaded wings designed in this way will have relatively small amounts of twist across the span. Author

N65-20497 Royal Aircraft Establishment, Farnborough (England).
AN IMPROVEMENT OF THE VELOCITY DISTRIBUTION PREDICTED BY LINEAR THEORY FOR WINGS WITH STRAIGHT SUBSONIC LEADING EDGES
D. G. Randall London, Min. of Supply, Sep. 1958 22 p refs
(RAE-TN-AERO-2577)

When the supersonic flow over a nonlifting wing with straight subsonic leading edges is calculated by thin wing theory, the results are unacceptable in a small region near the leading edge. By satisfying the boundary condition on the wing more exactly near the leading edge, a solution of the linearized equation is obtained which gives plausible results there. Elsewhere on the wing it gives results which are in agreement with thin wing theory. Author

N65-20498# Royal Aircraft Establishment, Farnborough (England).
AN APPROXIMATE METHOD OF CALCULATING THE LAMINAR BOUNDARY LAYER ON A DELTA WING
J. C. Cooke London, Min. of Supply, Nov. 1958 42 p refs
(RAE-TN-AERO-2595)

A method is developed for calculating the laminar boundary layer over a flat—or at least a thin—delta wing. Conical irrotational flow over the surface is assumed. This provides great simplification, but is a serious limitation to the method. However, there are some shapes in which the assumption is approximately true. The method is an adaptation of one due to Zaat, and depends on the momentum equations and on the assumption that the velocity in the boundary layer perpendicular to the external streamlines is small. Two variants of the method are described, depending upon the coordinate system used; each is applied to examples. Author

N65-20499# Royal Aircraft Establishment, Bedford (England).
A SEMI-EMPIRICAL METHOD FOR ESTIMATING THE ROTARY ROLLING MOMENT DERIVATIVES OF SWEPT AND SLENDER WINGS

W. J. G. Pinsker London, Min. of Supply, Aug. 1959 26 p refs (RAE-TN-AERO-2641)

A method is derived for estimating the derivatives l_p and l_r of swept and delta wings based on theoretical data and steady six-component wind tunnel results. Good agreement is obtained with values of l_p measured on a rolling balance for a series of narrow delta wings. Author

N65-20500# Royal Aircraft Establishment, Farnborough (England).

THE FLOW PAST A THIN WING WITH AN OSCILLATING JET FLAP

D. A. Spence London, Min. of Aviation, Aug. 1964 51 p refs (RAE-TN-AERO-2990)

An exact solution is obtained for the linearized flow past a thin two-dimensional wing of chord c at zero incidence in an incompressible stream of density ρ and undisturbed velocity U, with a thin jet of momentum-flux $2\rho U^2 c\mu$ emerging from its trailing edge at an oscillating deflection-angle $\tau \exp(i\omega U t/c)$. The motion is governed by a singular third-order integrodifferential equation, which becomes tractable when μ is small: solutions in this weak-jet limit depend on a single parameter $\nu = \mu\omega$, and are found to exist only when $\nu \leq 2$. The possible significance of this critical frequency is discussed. Computations of jet shape and lift force for a range of values of ν are presented, and the solutions for periodic plunging and pitching motions of the wing are derived from that for deflection. Author

N65-20503# Royal Aircraft Establishment, Bedford (England).

BOUNDARY LAYER MEASUREMENTS AT LOW SPEED ON TWO WINGS OF 45° AND 55° SWEEP

G. G. Brebner and L. A. Wyatt London, Min. of Aviation, Aug. 1960 84 p refs (RAE-TN-AERO-2702)

Boundary-layer flow and balance measurements were made on two sweptback wings. The first wing of 45° sweep, constant chord and aspect ratio 5, had a 12% thick 101 section. The boundary layer was measured at a number of different spanwise and chordwise positions for several incidences up to 6.3°. The wing was tested with and without roughness on the leading edge. The boundary-layer thickness with roughness was of the order of 50% greater than with the smooth leading-edge. The second wing had 55° sweep at the trailing-edge, constant chord as far as mid semispan and a curved leading edge thereafter. It had a 4 1/2% thick 101 section and aspect ratio of 3.4. The boundary layer was measured at mid semispan only, at three incidences up to 7.2° and at various chordwise positions from 40% chord back to the trailing edge. Wake measurements just behind the trailing edge were used to estimate the sectional profile drag at mid semispan. Author

N65-20505# Royal Aircraft Establishment, Bedford (England).

CALCULATIONS OF THE RESPONSE OF A FLEXIBLE SLENDER WING AIRCRAFT TO DISCRETE VERTICAL GUSTS

E. Huntley London, Min. of Aviation, Jul. 1961 28 p refs (RAE-TN-AERO-2771)

The bending response of a slender delta aircraft to sharp-edged and ramp-type gusts was evaluated in a simplified manner by considering only heave and longitudinal bending in the first normal mode; it is assumed that the aerodynamic forces act instantaneously on passage of the gust. The results show that because of the finite time for immersion of the aircraft in the gust, the values of the dynamic overshoot factors can vary within much wider limits than those for an aircraft with spanwise bending. At low speeds and for a sharp-edge gust, the value of the dynamic overshoot factor approaches 3, but at higher speeds and for a gust ramp length longer than 100 ft, the value of this factor appears to be less than for a conventional aircraft. Author

N65-20513# Royal Aircraft Establishment, Farnborough (England).

SUPERSONIC WIND TUNNEL MEASUREMENTS OF THE LOADS AND INTERNAL PRESSURE DISTRIBUTIONS ON DUCTS AT INCIDENCE

P. H. Cook London, Min. of Aviation, Feb. 1964 66 p refs (RAE-TN-AERO-2951)

An attempt was made to find a method of estimating the external lift of full-scale engine nacelles and the internal lift of rectangular cross section ducts used to represent engine nacelles on wind-tunnel models. The results for the total lift curve slope of circular cross section ducts look promising in that an adequate collapse of the experimental data has been achieved. For the rectangular ducts, the internal lift at low incidence may be predictable if the internal flow Mach number is known, and the available results for total lift suggest a similar collapse to that achieved for the circular ducts. The experimental data for the rectangular ducts are limited. Author

N65-20515# Royal Aircraft Establishment, Farnborough (England).

A SEMI-EMPIRICAL PREDICTION METHOD FOR PRESSURES ON THE WINDWARD SURFACE OF CIRCULAR CONES AT INCIDENCE AT HIGH SUPERSONIC AND HYPERSONIC SPEEDS ($m \geq 3$)

J. R. Collingbourne, L. F. Crabtree, and W. J. Bartlett London, Min. of Aviation, Jun. 1964 32 p refs (RAE-TN-AERO-2967)

The so-called impact theory equation $Cp^* = K^* \sin^2\theta$ for a circular cone is written as the sum of three terms associated with axial, combined and transverse flows, respectively. By postulating that K^* in each term represents a limiting value as $M_\infty \cdot \theta \rightarrow \infty$ of coefficients K_a, K_b, K_c which are functions of variables like $M_\infty \cdot \theta$, a simple, semiempirical method is devised for predicting pressure distribution on the windward region of a circular cone which agrees well with experimental data up to large incidence angles. Numerically, the method is based on the small incidence theories of Taylor–Maccoll and Stone, and on experimental pressure distributions over cylinders placed normal to the stream. Author

N65-20517# Royal Aircraft Establishment, Farnborough (England).

DYNAMIC TESTS ON FREE-FLYING MODELS OF SLENDER WINGS SUBJECTED TO SIDEGUSTS

W. E. Gray London, Min. of Aviation, Aug. 1964 23 p refs (RAE-TN-AERO-2983)

Experiments with small dynamic models confirmed that the motion of slender wings with fixed controls initiated by a sidegust is dominated by a dutch-roll oscillation during which large bank angles may be acquired. The tests revealed the importance of the changing forces and moments during penetration into a gust; these effects aggravate the severity of the rolling oscillation in cases where a long fuselage protrudes ahead of a thin wing and can lead to bank angles which are about twice those observed on a corresponding slender wing without fuselage. The presence of free forebody vortexes may complicate the response on entering a gust. Author

N65-20535# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
REPRESENTATION OF PROPELLER WAKES BY SYSTEMS OF FINITE CORE VORTICES Summary Report, Feb. 1963–Dec. 1964
W. G. Brady and P. Crimi Feb. 1965 72 p refs
(Contract Nonr-3691(00))
(CAL-BB-1665-S-2; AD-612007)

This report discusses the development of a propeller wake model and computational procedure aimed at the determination of the spatial distribution of wake vorticity and the associated induced velocity distribution. Numerical calculations were made for vortex-ring configurations corresponding to a hovering rotor at one-half, one, and two ring radii above the ground, as well as out-of-ground effect. Both unsteady and time-averaged velocities were computed at various points in the wake for several cases. In a model proposed for the wake flow of a rotor in steady forward flight the tip vortexes are represented by continuous finite-core vortexes. For purposes of numerical calculation, the continuous vortex is approximated by short straight-line segments. This model enables calculation of the time-dependent wake-vortex configuration, within the limitations of practicable computing running time, in which the various vortex elements move under mutual influence according to the laws of vortex dynamics. Author

N65-20635# Royal Aircraft Establishment, Farnborough (England).
LONGITUDINAL RESPONSE OF AIRCRAFT TO OSCILLATORY VERTICAL GUSTS (FREQUENCY ANALYSIS INCLUDING THE EFFECT OF UNSTEADY AERODYNAMICS)
J. K. Zbrozek London, Min. of Supply, Nov. 1955 54 p refs
(RAE-AERO-2559)

The theory of the longitudinal response of a conventional aircraft to oscillatory vertical gusts is developed, taking into account the unsteady aerodynamics. The formulas for calculations of aircraft heaving velocity and rate-of-pitch due to a sinusoidal gust are given in the exact form including unsteady aerodynamics, and in the approximate form using the classical approach to dynamic stability. It is concluded that for practical applications, the classical approach should be sufficient. However, the errors in the estimated rate-of-pitch could be significant, especially for small static margins. The formula for gust load frequency function is given; and it is shown that this function can be estimated with good accuracy and with small computational effort by calculating the aircraft motion and thus the effective incidence, neglecting the unsteady forces and taking into account the unsteady lift functions when calculating the aerodynamic loads due to effective incidence. Author

N65-20640# National Gas Turbine Establishment, Pyestock (England).
A COMPRESSOR ROUTINE TEST CODE
N. A. Dimmock Jan. 1961 66 p refs
(NGTE-R-246)

The routine testing of aircraft-type compressors—in the main axial flow, multistage compressors—requires a compromise between research accuracy and the practical considerations. This test code is the outcome of a survey of compressor testing techniques and instrumentation. The code aims at defining methods of measurement and weighting whereby compressor performance can be obtained sufficiently accurately for a realistic and direct comparison to be made between one compressor and another. The measurement of a quantity at a point in the fluid flow, and the averaging and weighting of such measurements were treated separately as far as is possible. Author

N65-20657# Royal Aircraft Establishment, Bedford (England).
OSCILLATORY DERIVATIVE MEASUREMENTS ON STING-MOUNTED WING TUNNEL MODELS: METHOD OF TEST AND RESULTS FOR PITCH AND YAW ON A CAMBERED OGEE WING AT MACH NUMBERS UP TO 2.6
J. S. Thompson and R. A. Fail London, Min. of Aviation, Jul. 1962 75 p refs
(RAE-AERO-2668)

A method is described which has been developed for measuring oscillatory derivatives on sting-mounted models in the 8- by 8-ft supersonic tunnel. Direct and cross derivatives with respect to angular displacements and velocities in pitch and yaw were measured satisfactorily, and results are given of tests on a cambered ogee wing at six Mach numbers from 0.2 to 2.6. Some tests were made on this model in the course of the preliminary development work in the 13- by 9-ft low-speed wind tunnel, and results of these are included. Author

N65-20658# Royal Aircraft Establishment, Farnborough (England).
AEROELASTIC MODELLING
W. G. Molyneux London, Min. of Aviation, Mar. 1964 56 p refs
(RAE-TN-STRUCT-353)

The requirements for aeroelastic similarity between an aircraft and a model are established from a consideration of the governing differential equations. The applications of these requirements, and the basic features of aeroelastic modeling techniques, are discussed in relation to three specific flow regimes, namely: low speed flow, neglecting compressibility effects; compressible flow, neglecting kinetic heating effects; and compressible flow with kinetic heating effects included. Author

N65-20659# National Gas Turbine Establishment, Pyestock (England).
THE DESIGN-POINT PERFORMANCE OF MODEL INTERNAL-EXPANSION PROPELLING NOZZLES WITH AREA RATIOS UP TO 4
M. V. Herbert and D. L. Martlew London, Min. of Aviation, Apr. 1964 15 p A Digest of Rept. No. R-258
(NGTE-R-258A; NGTE-R-258)

The construction of a new dry-air thrust rig is described, for testing model propelling nozzles in quiescent air, and its pretensions to accuracy are examined. Use was made of certain types of convergent nozzle as a means of checking the absolute level of airmass flow measurement. Experimental results were obtained for the performance of a family of conically divergent nozzles running correctly expanded, and were compared with theoretical estimates of the contributory losses. Other basic shapes of internal-expansion nozzle, both axisymmetric and two dimensional, were also tested. Author

N65-20665# Royal Aircraft Establishment, Farnborough (England).
A THEORETICAL DETERMINATION OF THE FLOW PAST AND THE AIR FORCES ON AN OSCILLATING SLENDER DELTA WING WITH LEADING-EDGE SEPARATION
D. G. Randall London, Min. of Supply, Mar. 1963 78 p refs
(RAE-R-STRUCT-284)

A symmetrical, flat, slender delta wing is oscillating harmonically; it is assumed that the flow has separated from the leading edge. If the amplitude of oscillation is small compared with the incidence in the mean position, it is possible to consider the oscillatory motion as a linear perturbation of a steady

motion, and this greatly simplifies the analysis. The flow field is determined by an extension to unsteady flow of the theory of Brown and Michael (which represents the phenomenon of leading-edge separation by isolated vortices joined to the leading edge by cuts). Agreement of this simple theory with experimental results is not discouraging. Author

N65-20672# Royal Aircraft Establishment, Farnborough (England).
MEASUREMENTS OF THE DYNAMIC CHARACTERISTICS OF A HEATED AND STATICALLY-LOADED MISSILE WING
D. J. Gilson and F. J. Hawkins Min. of Aviation, Oct. 1964 19 p ref
(RAE-TR-64022)

Experiments were made on the wing and midbody portion of an air-to-air missile to measure the dynamic characteristics of the wing under static load and heating. The experiments indicate that the natural frequencies of the wing are reduced by heating and increased by static loading, the latter effect being small compared with the former. Author

N65-20714# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THEORY OF A WING OF FINITE SPAN, OSCILLATING HARMONIOUSLY
N. N. Polyakhov 4 Jan. 1965 15 p refs Transl. into ENGLISH from Vestn. Leningr. Univ., Ser. Mat., Mekh. i Astron. (Leningrad), no. 19, 1957 p 87–97
(FTD-TT-64-606/1+2; AD-610292)

A generalization of the Birnbaum–Kussner method was developed for a wing of finite span with harmonic oscillation. Expressions were derived for a rectangular wing with constant circulation, variable circulation, and for the case where the wing aspect ratio is not very small. E.E.B.

N65-20733# Royal Aircraft Establishment, Farnborough (England).
MEASUREMENTS OF VORTEX-BREAKDOWN POSITION AT LOW SPEED ON A SERIES OF SHARP-EDGED SYMMETRICAL MODELS
P. B. Earnshaw Nov. 1964 12 p refs
(RAE-TR-64047)

Measurements were made at low speed of vortex-breakdown positions on a series of five symmetrical wings, using a schlieren system to detect the position of breakdown. The results suggest that the modification of a delta planform to incorporate streamwise tips has little effect on breakdown position when this is forward of the modified tip. Examination of the large differences between these measurements and those from other sources suggests that the influence of cross-sectional shape, even on nominally thin wings, may be larger than expected and merits further investigation. Author

N65-20742# Royal Aircraft Establishment, Farnborough (England).
THE ESTIMATION OF THE THREE-DIMENSIONAL GYRATIONS OF A BALLISTIC MISSILE DESCENDING THROUGH THE ATMOSPHERE
G. S. Green and A. K. Weaver London, Min. of Aviation, Dec. 1961 62 p refs
(RAE-TN-GW-596)

This paper provides a relatively simple analytic method for estimating the variation of the angular disturbances, in pitch and yaw, of a ballistic missile spinning about its axis as it descends through the atmosphere. The formulas developed, are capable of application to a wide range of cases, including any missile design which consists of a body with axial symmetry. Its principal restriction is that the pitch or yaw disturbance must be small. The results should be applicable to many practical cases. The rate of spin of the missile can be of any size, and the case of zero spin is included in the formulas as a special case. A comparison, for some typical cases, between results predicted by the formulas and those calculated by exact solution using a digital machine showed excellent agreement. Author

N65-20961# Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (West Germany). Institut für Aerodynamik
THEORETICAL AND EXPERIMENTAL INVESTIGATIONS ON WINGS OF FINITE SPAN WITH JET FLAPS [THEORETISCHE UND EXPERIMENTELLE UNTERSUCHUNGEN AN TRAGFLUGELN ENDLICHER SPANNWEITE MIT STRAHLKLAPPEN]
A. Das Nov. 1964 73 p refs In GERMAN; FRENCH and ENGLISH summaries
(FL-64/12; DLR-FB-64-40) Available from ZLDI, Munich: 11 DM

A general lifting surface theory for jet-flapped wings was presented; it was undertaken to apply the theory to various examples and to check the theoretical results with experiments. This paper deals with wings of various planforms (rectangular-, swept- and deltawings) having different aspect ratios and provided with blowing from the trailing edge. The angle of blowing, the jet momentum coefficient and in some cases the arrangement of blowing were varied in a given range. The jet momentum coefficient could be varied from $C\mu=0$ to 2.0. The experimental investigation was confined only to measurement of pressure distribution on the wing surface, from which the aerodynamic forces and moments were determined through integration. The theoretical results show good agreement with the experimental values. Author

N65-20992*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PERFORMANCE OF SEVEN SEMICIRCULAR LIFT-PRODUCING NOZZLES
Charles J. Shoemaker Washington, NASA, Apr. 1965 46 p refs
(NASA-TN-D-2731) CFSTI: HC $2.00/MF $0.50

An investigation of the trust coefficient and lift force produced by seven semicircular lift-producing nozzles was conducted with air at ratios of total pressure to ambient pressure up to 1000. The nozzle-exit Mach numbers ranged from 2.22 to 4.54. The models were originally circular cross-section nozzles designed by the method of characteristics for uniform axial flow at the exit. These circular nozzles were split, and a flat plate was substituted for the lower half. The models were further modified to produce lift by cutting notches in the trailing edge of the flat plate. Test results of each configuration are given. Notching the flat plate did not significantly affect the thrust coefficient. A lift–thrust ratio of 0.21 was the maximum value recorded. Author

N65-20997*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ANALYTICAL STUDY OF EFFECTS OF PRODUCT OF INERTIA ON AIRPLANE SPIN ENTRIES, DEVELOPED SPINS, AND SPIN RECOVERIES
Ernie L. Anglin Washington, NASA, Apr. 1965 49 p refs
(NASA-TN-D-2754) CFSTI: HC $2.00/MF $0.50

An analytical study was made to investigate the effects of variations in product of inertia on the spin entry, developed spin, and spin recovery of airplanes. Three configurations considered to be representative of modern fighter-type airplanes

were used: a delta-wing fighter, a swept-wing fighter, and a stub-wing research vehicle. They were mass loaded relatively heavily along the fuselage. The results indicate that the magnitude of the product of inertia may have a significant effect on attempted spin-entry motions. For the delta-wing fighter and the swept-wing fighter, an increase in product of inertia changed the attempted entry motion from one in which a developed spin was attained to one in which no spin resulted. For developed spins, increasing the product of inertia caused slightly higher angles-of-attack, somewhat lower rates of rotation, and lower magnitudes of spin-energy factor resulting in fewer turns required for recovery. When spins are oscillatory, the trends noted for developed spins are somewhat obscured. Author

N65-21060# ARO, Inc., Arnold Air Force Station, Tenn.
LIFT, DRAG, AND STATIC STABILITY OF A BLUNT CONICAL MODEL IN HYPERSONIC RAREFIED FLOW Technical Report, Jun. 20–Jul. 15, 1964
David E. Boylan Arnold Eng. Develop. Center, Mar. 1965 31 p
(Contract AF 40(600)-1000)
(AEDC-TR-65-62; AD-460154)

This is a report of results and analysis of measurements of forces on spherically capped cones of 10° half-angle, with and without conical afterbodies. These data were obtained during the course of an evaluation of a new three-component balance for use in a low-density, hypersonic wind tunnel. Comparisons are made with modified Newtonian and free-molecule theories. Measurements were made in nitrogen gas at a nominal Mach number of 9.8 and unit Reynolds number of 760 $in.^{-1}$. The suitability of the low-load, three-component balance for measuring aerodynamic forces in low-density flows is demonstrated. Author

N65-21068# National Aero- and Astronautical Research Inst., Amsterdam (Netherlands).
SOME COMPARATIVE CALCULATIONS WITH THE LIFTING SURFACE THEORY OF LASCHKA FOR CIRCULAR AND ELLIPTIC WINGS OSCILLATING IN SUBSONIC FLOW
R. J. Zwaan 28 Sep. 1964 35 p refs
(NLR-TN-F.241)

The lifting surface theory of Laschka was applied to circular and elliptic wings oscillating in subsonic flow, and comparisons made with results of more analytic procedures. The influence of the chordwise position of the collocation points was investigated. Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N65-20162*# National Aeronautics and Space Administration, Washington, D. C.
X-15 RESEARCH RESULTS WITH A SELECTED BIBLIOGRAPHY
Wendell H. Stillwell 1965 135 p refs
(NASA-SP-60) GPO: $0.55; CFSTI: MF $1.00

New objectives and past accomplishments are summarized for the X-15 flight research program. Its role as a research laboratory for high-altitude experiments and hypersonic component testing demonstrates its usefulness in areas inaccessible to rockets and satellites. The aircraft's research and development, configuration, powerplant, supersonic–hypersonic flight aerodynamic characteristics, hypersonic structure, flight dynamics, and man–machine integration are presented. R.N.A.

N65-20482*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SUMMARY OF V-G DATA OBTAINED FROM TURBINE-POWERED TRANSPORT AIRPLANES FROM 1959 TO 1963
Walter G. Walker Washington, NASA, Apr. 1965 21 p refs
(NASA-TN-D-2740) CFSTI: HC $1.00/MF $0.50

Normal acceleration and airspeed data obtained with NASA V-G recorders installed on two types of turboprop and three types of turbojet commercial transport airplanes were analyzed to determine the frequency of occurrence and the severity of the in-flight accelerations experienced. The data cover approximately 176 000 hours of flight on eight different U.S. airlines during operations from 1959 to 1963. The results indicate that the frequencies per flight mile of the occurrence of acceleration increments equaling or exceeding ± 1.4 g ranged from about 1.1×10^{-7} to 3.0×10^{-6} for the four-engine turbine transports. For the operations of a two-engine turboprop transport, the frequency of occurrence was about 7.0×10^{-6}. Such variations in the acceleration experiences are not unusual. From overall considerations, the frequency of occurrence of large accelerations in the turbine transports does not appear to be appreciably different from that observed previously in piston-transport operations. However, the largest accelerations for the turbine transports tend to occur at random throughout the design airspeed range; whereas for piston transports, the largest accelerations were usually experienced at low speeds relative to the design airspeed range. Author

N65-20510# Royal Aircraft Establishment, Farnborough (England).
MEASUREMENTS OF "AQUAPLANING HEIGHT" ON A METEOR AIRCRAFT, AND PHOTOS OF FLOW PATTERN UNDER A MODEL TYRE
W. E. Gray London, Min. of Aviation, Nov. 1962 11 p ref
(RAE-TN-AERO-2855)

Experiments with a meteor aircraft to measure the gap between tire and runway under high speed and flooded conditions are described. Water depths were varied from 1/8 in. to 1.0 in., and most of the tests were at 90 knots, at which speed the tire was well off the ground in 1/4 in. of water. Clearances were measured by small ridges of plasticine, and some evidence was obtained of tire distortions and of water velocity under the tire. Qualitative studies of the liquid thickness in the footprint area of a small model tire were made and photographs taken showing the flow directions and velocities under the tire. To do this, the model tire was run in contact with the inner wall of a transparent drum. A selection of photographs is given. Author

N65-20688# RAND Corp., Santa Monica, Calif.
PLANNED REPLACEMENT
Chauncey F. Bell and Milton Kamins Jan. 1965 12 p refs Submitted for Publication
(P-3052; AD-610285)

The characteristics of a planned replacement policy were examined to determine when and how to apply the policy in order to achieve the most desirable results. The major purposes of such a policy for selected components in aircraft

and missiles are increased safety, improved reliability, and greater economy. If these objectives can be met, other advantages also accrue such as increased in-commission time and improved operational effectiveness. Two conditions are necessary to make planned replacement worthwhile. First, there must be some advantage to avoiding an unexpected failure, or a failure in service. Second, planned replacement must reduce the chance that a failure will occur. The new component must be better and more reliable, than the part being replaced. E.E.B.

N65-20731# Royal Aircraft Establishment, Farnborough (England).
VARIATION OF HELICOPTER CAPACITANCE WITH ALTITUDE
M. E. Rogers and E. B. M. Minihan London, Min. of Aviation, Apr. 1964 36 p refs
(RAE-TN-IEE-43)

A method is discussed for studying the variation of helicopter capacitance with altitude by using scaled models in conjunction with a large conducting plane. Helicopters were investigated over the height range 6 to 150 feet. Significant decreases in aircraft capacitance were found to occur up to heights of 100 feet; above this little change occurred as the values approached the free space capacitance of the helicopters. Difficulty was experienced in obtaining true capacitance measurements because field distortion severely limited the effective area of the conducting plane. However it was found possible to allow for this and it is estimated that the overall accuracy was better than 5%. Author

N65-20859# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
POWERED ORNITHOPLANE
I. N. Vinogradov, R. I. Vinogradov, and V. M. Andreyev 7 Jan. 1965 7 p Transl. from Soviet Patent No. 159407 (Appl. no. 814470/40-23, 21 Jan. 1963) 4 p
(FTD-TT-64-630/1+2; AD-610296)

A powered ornithoplane—a monoplane with horizontal and vertical empennage, triwheel landing gear, mechanized in-suction louvers, ejector wing, and hydraulic power—is described. To increase lift and thrust, feather-like vanes, and propellers constructed of feather-like synthetic materials are located at the wing tips. The vanes are arranged in fan-shape and execute reverse-torsion oscillations. Side flaps are mounted on the horizontal empennage for transverse control, capable of being deflected on every side and connected with cable wire and slats. Illustrations are included. E.E.B.

N65-20877*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
COMPARISON OF MEASURED AND CALCULATED SONIC-BOOM GROUND PATTERNS DUE TO SEVERAL DIFFERENT AIRCRAFT MANEUVERS
Donald L. Lansing and Domenic J. Maglieri Washington, NASA, Apr. 1965 35 p refs
(NASA-TN-D-2730) CFSTI: HC $2.00/MF $0.50

Detailed comparisons of the measured and calculated ground shock pressure patterns resulting from aircraft performing pushover-dive-pullout, longitudinal-acceleration, pullup-climb-pushover, and circular-turn maneuvers are presented. Calculations of the arrival time of the shock wave and the pressure amplitude as a function of distance along the ground are compared with the measurements from an array of microphones. Specific cases are also presented in which the superboom phenomena were obtained. The comparison between acoustic theory and experiment indicates that the theoretical method used is capable of predicting the essential features of the ground shock patterns of aircraft in maneuvers at altitudes below 30000 to 40000 ft at least when the sound-speed gradient is nearly linear. The theory predicts the correct number of N-waves which will occur in the vicinity of a given ground area, and gives reasonable estimates of the time elapsed between the generation of the boom and its arrival on the ground. The calculated elapsed times are a few seconds less than those measured. The calculated overpressures either agree well with measurements or give a slight overestimate in those ground areas which do not experience superboom phenomena. The results suggest that the location of superboom phenomena can be predicted to within plus or minus 2 to 3 miles, provided accurate aircraft position information and weather data are available. Author

N65-20901# Edo Corp., College Point, N. Y.
DESIGN AND INSTALLATION OF GRUNBERG HYDROFOIL SYSTEM ON THE JRF-5 AIRPLANE Final Engineering Report
Nov. 1964 43 p refs
(Contract NOas-58-430-c)
(Rept.-6651; AD-460339)

This report describes the design, fabrication and installation of a supercavitating hydrofoil system on an airplane. The system consists of a single, inverse taper, supercavitating foil, on two end struts, located approximately below the airplane center of gravity, stabilized by two planing skids attached to struts extending forward from the bow. The engineering tasks associated with the various phases of the program resulting in the full-scale test aircraft are covered in the body of this report. Author

N65-21033# Raven Industries, Inc., Sioux Falls, S. Dak.
SKYHOOK CHURCHILL 1964 Final Report
G. W. Fendrich 31 Dec. 1964 157 p
(Contract Nonr-3390(12))
(Rept.-2164; AD-610152)

This report covers fabrication and supply of balloons and balloon safety, destruct, and flight control instrumentation. Performance of necessary launching, aircraft tracking and recovery operations for each flight are also discussed. The background of the selection of Ft. Churchill as launch site and a description of present facilities there, are covered, as are tracking and recovery techniques, and a description of the flight control instrumentation. Author

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N65-20375# Martin Co., Baltimore, Md. Nuclear Div.
RESEARCH PROGRAM ON APPLICATION OF JET COMPRESSOR TO MAGNETOPLASMADYNAMIC ELECTRICAL POWER GENERATION Final Report, 1 Jun. 1963–30 Nov. 1964
Cheng Shih [1964] 48 p refs
(Contract Nonr-4087(00))
(MND-3176; AD-610151)

The feasibility of using a metallic vapor of high molecular weight to compress a gas of low molecular weight was confirmed. Thermal efficiencies of about 10% were obtained. The test setup consisted of a gaseous loop and a condensing-vapor loop. The gaseous loop contained helium saturated with cesium vapor and formed the secondary stream, simulating the working medium of a magnetoplasmadynamic power generator. In the condensing-vapor loop, pure cesium is vaporized, superheated, and discharged under high pressure through a convergent–divergent nozzle to form the primary stream of the jet compressor. After mixing of the two streams and diffusion to low velocity, the cesium is then condensed, separated from the gas, and pumped back to the boiler to repeat the cycle. With the helium system at 0.245 atm at 633° K, and with the cesium vapor at 6.45 atm at 1590° K, and a flow rate of 8 gram/sec, the resulting performance was a helium pressure rise of 36% at a flow rate of 1.12 gm/sec. E.E.B.

N65-20416*# AiResearch Mfg. Co., Los Angeles, Calif.
RECUPERATOR DEVELOPMENT PROGRAM, SOLAR BRAYTON CYCLE SYSTEM Progress Report, 19 Jul.–19 Aug. 1964
A. F. Anderson and E. F. Timpke 31 Aug. 1964 22 p
(Contract NAS3-2793)
(NASA-CR-57617; L-9375; AM-288) CFSTI: HC $1.00/MF $0.50

Selection of a fin heat exchanger for a solar, closed Brayton cycle system is described. Design parameters were determined, using a computer program, which optimize weight and volume of the heat exchanger and the pressure losses at the triangular ends required to introduce and remove argon from both sides of the heat exchanger. The input and output of this program, with an example, are shown. Dimensions of the recuperator for the Brayton system, based on the choice of a fin heat exchanger, are given; the recuperator model is considered too heavy, and means are discussed for reducing its mass. J.M.D.

N65-20417*# AiResearch Mfg. Co., Los Angeles, Calif.
RECUPERATOR DEVELOPMENT PROGRAM, SOLAR BRAYTON CYCLE SYSTEM Progress Report, Nov. 1964–Jan. 1965
L. E. Evans 1 Feb. 1965 8 p
(Contract NAS3-2793)
(NASA-CR-57620; L-9379) CFSTI: HC $1.00/MF $0.50

Recuperator weights were determined for pressure drops ranging from 1.5% to 3% and for effectiveness from 88% to 91%. Curves representing the results of a detailed analysis of these parameters for the flight weight recuperator are presented. Axial conduction was considered in the analysis, but flow distribution was not. R.N.A.

N65-20420*# Thompson Ramo Wooldridge, Inc., Cleveland, Ohio. Tapco Div.
SUNFLOWER POWER CONVERSION SYSTEM Quarterly Report, Mar.–May 1963
[1963] 35 p Sponsored by NASA
(NASA-CR-57643; ER-5386) CFSTI: HC $2.00/MF $0.50

Component test rig activities were conducted in support of turbo–alternator testing. Turbo–alternator CSU 1-3A accumulated 768 hours of continuous endurance testing before stopping when foreign particles entered the first-stage nozzle from the component testing. During the last few hours of operation, step changes in power output were observed with subsequent reduction of flow in the test rig. Continued hydrogen permeability measurements include the following samples: Croloy 9M material, solaramic coated Croloy 9M sample, Haynes #25 sample coated with a complex Mo–Si coating, tungsten, titanium coated Haynes #25, and vandium coated 304 stainless steel. Hydrogen was injected into the pump through the superheater and subcooler inlet ports and was removed through a section of Haynes #25 tubing in the condenser section. A columbium window section was also in the condenser. The test results indicate that the hydrogen is collecting in the superheater section and is not being transported to the columbium window section where it should diffuse into the collection chambers, and, that the pump will operate at high speeds and high outlet pressures with minimum seal leakage. R.W.H.

N65-20489*# Union Carbide Corp., Parma, Ohio. Parma Research Lab.
STUDY PROGRAM TO IMPROVE FUEL CELL PERFORMANCE BY PULSING TECHNIQUES Quarterly Report, Period Ending Feb. 28, 1965
M. L. Kronenberg [1965] 29 p refs
(Contract NAS3-6460)
(NASA-CR-54337) CFSTI: HC $2.00/MF $0.50

It was observed that heavy discharge pulses significantly improve the performance level of fuel cells under certain conditions. Results indicate that pulsing is primarily a catalyst reactivation treatment and is most effective in improving the performance of electrodes that are catalyst-limited from the start, or become catalyst-limited during the life of the electrode. Diffusion-limited electrodes show no beneficial effect, and the deterioration of performance of a physically poor electrode cannot be helped by pulsing. Studies on nonporous platinum electrodes show that platinum rapidly loses its catalytic activity as an H_2-anode catalyst with time; however, the catalytic activity can be restored electrochemically by oxidative pulses, or by chemical oxidation. Author

N65-20536# Atomics International, Canoga Park, Calif.
BASIC RESEARCH IN THERMIONIC ENERGY CONVERSION Fourth Annual Technical Summary Report, 1 Nov. 1963–31 Oct. 1964
C. Warner and L. K. Hansen Dec. 1964 117 p
(Contract Nonr-3192(00))
(AI-64-271; AD-609893)

This report discusses a program to investigate basic processes in thermionic energy conversion important to a thermionic nuclear powerplant for naval applications. The subjects discussed are ignited mode and ion-rich unignited mode V-A characteristics; boundary conditions and ion generation mechanisms for the ignited mode; retarding field operation of thermionic diodes; ion production in the collector glow mode, and plasma boundary conditions using a generalized Yvon's analysis. Author

N65-20567# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering
PERFORMANCE AND FLUID FLOW CHARACTERISTICS OF AN ELECTRO-FLUID DYNAMIC GENERATOR
Jay Roy Roland (M.S. Thesis) Aug. 1964 107 p refs
(GA/ME/64-5; AD-610176)

This study investigated performance and fluid flow characteristics of an EFD (electrofluid dynamic) generator; its purpose was to experimentally determine the performance of an EFD generator using two different ground plate inserts under various conditions. The results of this study showed that the normal

ground plate insert gave better performance because of higher needle currents, and that the primary to secondary pressure ratio of three did not yield maximum needle current, as a pressure ratio of four gave a definite increase. The best performance of the EFD generator, limited by the maximum measurable voltage of 140 kV, was 35.0 W with a generator efficiency of 8.45×10^{-2}%. Author

N65-20637# Royal Aircraft Establishment, Farnborough (England).
AN EXPERIMENTAL STATIC INVERTER GIVING A THREE PHASE SINUSOIDAL OUTPUT
R. L. Piper London, Min. of Aviation, Mar. 1963 23 p refs
(RAE-TN-IEE-13)

A three-phase static inverter giving a 400-cps sinusoidal output is described. The circuit used is a modified form of the tuned transformer parallel inverter arrangement, and silicon controlled rectifiers are used as the switching elements. A three-phase output of 540 W from a dc supply of 28 V was obtained with the experimental model. The imperfections and limitations of the circuit are discussed. Author

N65-20646# Royal Aircraft Establishment, Farnborough (England).
SOME COLD GAS AUXILIARY JET CONTROL MECHANISMS AND PROPELLANTS FOR USE IN EARTH SATELLITES
B. P. Day and R. Hastings London, Min. of Aviation, Jun. 1961 34 p refs
(RAE-TN-GW-580)

Some gases suitable for use in cold-gas jet control systems are reviewed, and reasons are given for the selection of propane. Some of the development of small valve gear for flow control in a bang-bang attitude control system is described. Author

N65-20650# Royal Aircraft Establishment, Farnborough (England).
NOTES ON THE DESIGN OF STATIC INVERTERS
C. S. Hudson London, Min. of Aviation, Sep. 1960 17 p
(RAE-TN-EL-185)

The possibility that improved performance might be obtained by using pulse lengths less than 180° is considered. The behavior of three phase inverter circuits operating with pulse lengths of 60°, 120°, and 180° are examined. It is concluded that a 60° pulse length is desirable on account of circuit simplicity and weight. Problems of commutation and of operation on reactive loads are discussed. Author

N65-20653*# Space Technology Labs., Inc., Redondo Beach, Calif. Solid State Physics Lab.
[EFFECTS OF LOW ENERGY PROTON IRRADIATION ON SOLAR CELLS] Monthly Progress Report, Jan. 1965
J. M. Denney 19 Feb. 1965 2 p
(Contract NAS5-3805)
(NASA-CR-57558) CFSTI: HC $1.00/MF $0.50

Data were obtained on the I-V characteristics of solar cells irradiated in a sun-simulator low energy proton experiment. Subsequent measurements indicated that considerable annealing had occurred in both the p/n and n/p specimens. The extent of annealing was much greater than any previously observed in short-time measurements of proton or electron-irradiated cells. E.P.V.

N65-20654*# Naval Ammunition Depot, Crane, Ind.
SPACE CELL TEST PROGRAM Monthly Progress Report
E. R. Pettebone 31 Dec. 1964 113 p
(NASA Order W-11252-B)
(NASA-CR-57561) CFSTI: HC $4.00/MF $1.00

Life cycle tests of 5-cell and 10-cell packs of nickel cadmium, 10-cell packs of silver cadmium, and 5-cell packs of silver zinc cells continued. The observed test parameters were ambient temperatures, voltage limits, depth of discharge, and orbit times. Attached data sheets give the end of the discharge and the end of charge voltage reading for each cell and each cycle recorded. The cumulative failure analysis results are also shown. G.G.

N65-20685# Radio Corp. of America, Lancaster, Pa. Direct Energy Conversion Dept.
THE DEVELOPMENT OF A LOW-TEMPERATURE CYLINDRICAL THERMIONIC GENERATOR Quarterly Technical Report, Period Ending 30 Dec. 1964
W. B. Hall, W. E. Harbaugh, S. W. Kessler, R. W. Longsderff, and R. E. Shoemaker [1964] 49 p ref
(Contract AF 33(615)-1547)
(QTR-3; AD-609966)

An evaluation and analysis of the Type A-1198B insulated converter provided additional evidence that it is a reliable, long-life design, and that the cast alumina layer is an effective insulator. Improved Type A-1274A modules were fabricated and showed improved reliability in calibration tests. More than 240 hours of operating time were accumulated over a wide range of operating conditions. Although the A-1274A is capable of full design performance, additional collector cooling is required. Tests with the gas dosing injection system indicated the need for more accurate gas injection, and the system was subsequently modified. Collectors of cesium fluoride, cesium sulfate, tungsten trioxide, iridium matrix, and palladium matrix were tested in Type A-1194E converters in the low-work-function collector investigation and the results were unsatisfactory. Data were compiled and analyzed on both molybdenum and niobium high-temperature collectors. The results showed that collectors can be operated as high as 700° C (with an emitter temperature of 1350° C) without inordinate loss of power. Higher collector temperatures require a compromise between power and weight. Author

N65-20692# ASTRA, Inc., Raleigh, N. C.
A CHECK ON THE WEIGHT OF SPACE RADIATORS FOR STEAM SYSTEMS
Henry R. Kroeger 25 Feb. 1965 12 p refs
(ASTRA-G-71)

Calculations are illustrated for a near-optimum aluminum radiator designed for a 1000-kWe steam system. The radiator-condenser, a simple, all-aluminum, fin and tube construction, is described in detail. Input and output values for the aluminum radiator parameters are included. The weight per square foot of radiating surface was 0.31 lb/ft^2; the heat radiated per square foot of radiator surface was 0.15 kW (thermal)/ft^2; the specific weight of the effective radiating area was 2.07 lb/kW (thermal); the total radiating surface weight was 2.59/kW(thermal); and the specific weight of the radiator fin and tube section was 11.0 lb/kWe. Total weight estimates for other types of radiators for 1000-kWe steam space power systems are included. E.E.B.

N65-20706# Melpar, Inc., Falls Church, Va.
A THIN-PLATE BATTERY Supplement to Third Quarterly Report on Thin-Film Monotronics, 12 Sep.–12 Dec. 1964

J. Smit and K. C. Channabasappa [1964] 25 p refs
(Contract NOw-64-0568-d)
(AD-609999)

Development of a self-contained ammonia battery composed of two 15-cell sections capable of a 150-watt power output led to the fabrication and evaluation of several 15-cell, 40-cm^2 area battery packs. It was concluded from the results that the data generated from small batteries can be extrapolated to the fabrication of larger battery units with greater power outputs. Also considered were (1) definition of the effect of low current drain rates on the ammonia battery life; (2) determination of the effect of long activated stand times on the ammonia battery performance; (3) selection of a self-contained unit incorporating the electrodes, electrolyte, and activation mechanism for further testing; and (4) feasibility studies on the use of aluminum as a casing material for NH_4SCN-NH_3 solutions. Test runs with 15-cell, 40-cm^2 area batteries showed a power output of nearly 70 watts for 6 minutes indicating that internal structural supports do not impede activation. G.G.

N65-20756*# Electro-Optical Systems, Inc., Pasadena, Calif.
DESIGN STUDY OF A SOLAR HYDROGEN PROPULSION AND POWER SYSTEM Quarterly Report, 17 May 1963–17 Aug. 1963
F. Mac Farlane 9 Sep. 1963 74 p refs
(Contract NAS7-231)
(NASA-CR-57743; EOS-4000-Q-1) CFSTI: HC $3.00/MF $0.75

Component studies were completed; relationships for the cryogenic storage system, solar concentrator size, thrust levels, electrical power, and other efficiencies at different solar distances were formulated; and subsystem integration studies of the cavity with combined hydrogen heat exchanger and thermionic converter were initiated. Also, the feasibility of the concept for the combined cavity–absorber was indicated. A preliminary analysis of a solar probe mission system showed that the combined solar propulsion–power system may offer significant performance advantages over electric propulsion or chemical rockets. E.E.B.

N65-20760# Federal Aviation Agency, Oklahoma City, Okla. Aeronautical Center
FUEL CELLS Selected References, 1953 through Mar. 1964
Lois J. Stout, comp. Nov. 1964 105 p refs *Its* Bibliographic List No. 2
(AD-608880)

This bibliography contains 495 articles on fuel cells arranged by subject, and includes a personal name index. E.E.B.

N65-20791*# Thompson Ramo Wooldridge, Inc., Cleveland, Ohio. TAPCO Div.
SOLAR RANKINE SYSTEM PERFORMANCE AND STATUS SUMMARY
24 Jul. 1962 141 p
(NASA-CR-57765; ER-4955) CFSTI: HC $4.00/MF $1.00

It was concluded that there are no remaining areas of uncertainty regarding the feasibility of solar mercury Rankine systems. This specifically includes mercury compatibility, hydrogen containment, endurance capability, and reliability. Also, the performance of the Sunflower system can be significantly improved by increasing output power, reviewing detailed specifications, and by increased investment of time and money. Further, the Rankine system offers unique advantages of simplicity and performance. E.E.B.

N65-20804*# Electro-Optical Systems, Inc., Pasadena, Calif.
HYDROGEN-OXYGEN ELECTROLYTIC REGENERATIVE FUEL CELLS
M. Klein 20 Jan. 1965 67 p ref
(Contract NAS3-2781)
(NASA-CR-57661; EOS-4110-2Q-2) CFSTI: HC $3.00/MF $0.75

A single cell unit was produced to establish optimum design characteristics and to evaluate the effect of changes in such controllable variables as the asbestos matrix, temperature, charge rate, discharge rate, and electrode catalyst loading. Also, two 6-cell units were fabricated and a 75-watt unit was successfully cycled over an extended period of time. Performance exceeded nominal output levels. Subsequent cycling on the same unit indicated that levels greater than 90 watts could be obtained and, by increasing the operating temperature from 70° to about 125° C, outputs approaching 120 watts are obtainable. The primary factors resulting in the greatly improved performance and reliability were: (1) increased electrode catalyst loading from 10 mg/cm^2 to 20 mg/cm^2; (2) improved bipolar plate design; (3) use of fuel cell grade asbestos instead of electrolytic or commercial grades; and (4) improved volume compensation bellows design. Performance data and design details are included. E.E.B.

N65-20805*# Electro-Optical Systems, Inc., Pasadena, Calif.
HYDROGEN-OXYGEN ELECTROLYTIC REGENERATIVE FUEL CELLS
Harvey Frank 10 Apr. 1964 3 p
(Contract NAS3-2781)
(NASA-CR-57663; EOS-4110-M-7) CFSTI: HC $1.00/MF $0.50

Poor grade asbestos of high diffusion rate was found to be the cause of internal gas mixing, and this led to malfunction of the six-cell unit. A new unit of impermeable grade asbestos functioned well for seven complete and two partial cycles with an average charge voltage of 9.6 volts at 9.6 amps, and a discharge voltage of 4.4 volts at 16.6 amps. Subsequent failure at the end of the ninth cycle was probably caused by a dry spot on one of the electrodes. G.G.

N65-20806*# Electro-Optical Systems, Inc., Pasadena, Calif.
HYDROGEN-OXYGEN ELECTROLYTIC REGENERATIVE FUEL CELLS
Harvey Frank 10 Jun. 1964 6 p
(Contract NAS3-2781)
(NASA-CR-57770; EOS-4110-ML-9) CFSTI: HC $1.00/MF $0.50

Test run using viton rubber gaskets and a modified asbestos matrix separator bed showed degradation after 36 hours and a poor cell performance. Analysis of the disassembled cell seemed to indicate electrode contamination due to asbestos permeability. The next run with new electrodes, silicone rubber gaskets, and an asbestos matrix consisting of two layers of 0.020 material and one of 0.035 material showed an abnormal impedance to electrolyte flow and poor cell performance on both charge and discharge during 10 hrs of operation. Another test run using silicone gaskets and two layers of 0.035 material indicated a cell stack leak at the standard cell stack torque of 40 inch-pounds. The leak was stopped by an increase in the asbestos compression, but subsequent performance did not improve upon reassembly. Asbestos permeability studies are being continued and a roll of 0.060 electrolytic grade asbestos was obtained for evaluation. G.G.

N65-20807*# Electro-Optical Systems, Inc., Pasadena, Calif.
HYDROGEN-OXYGEN ELECTROLYTIC REGENERATIVE FUEL CELLS
Harvey Frank 10 Dec. 1963 9 p
(Contract NAS3-2781)
(NASA-CR-57665; EOS-4110-M-4) CFSTI: HC $1.00/MF $0.50

Design of the fuel cell assembly was completed. Also, the cycle controller design was established. A few modifications of the first fuel cell design were made to improve reliability and simplify fabrication. The first such modification consisted of increasing the diameter of the separators to provide more sealing area for the Teflon gaskets. A second change consisted of increasing the thickness of the separators to simplify the machining of the inlet radial holes which serve as inlet gas ports. Five oxygen electrodes were completed. A sample of butyl rubber from which the balance diaphragm is to be made was held at 100° C for 5 days under 100 psig of oxygen. No apparent change in surface properties or elasticity was noted. Samples of magnesium and aluminum were subjected to the same tests with no apparent change in the metal surfaces. Kanigen plated nickel was tested under electrolysis. No signs of penetration into the substrate material were noted. Single cell data were also included. E.E.B.

N65-20808*# Electro-Optical Systems, Inc., Pasadena, Calif.
HYDROGEN-OXYGEN ELECTROLYTIC REGENERATIVE FUEL CELLS
E. Findl 15 Aug. 1964 11 p
(Contract NAS3-2781)
(NASA-CR-57666; EOS-4110-ML-10) CFSTI: HC $1.00/MF $0.50

A factor governing the usage of porous asbestos as the separator material in the H_2-O_2 regenerative cell is the degree to which it must be compressed to prevent gas leakage. Measurements were made of the breakover pressure of two combinations of asbestos thickness that totaled 0.070-inch matrix thickness. This breakover pressure is the differential pressure required to initiate a measurable H_2 leakage through the asbestos. The electrolyte/asbestos ratio used was 0.6:1, the compression ratio used was 7:4 and the gas used was hydrogen. Design changes were recommended to improve reliability and performance of the multicell, 75-watt unit. Changes were made to simplify fabrication and assembly, to increase gas porting area to the pressure balancing bellows, and to minimize the hazards involved in testing. The single cell, designed to evaluate electrode performance, contains features similar to those used on the multicell unit but does not contain a pressure balancing mechanism. Therefore, the H_2 and O_2 tank volumes within the cell must be carefully balanced prior to its use in the regenerative mode of operation. The design of the pneumatic and electronic instrumentation for the single and multicell units has been completed. R.W.H.

N65-20809*# Electro-Optical Systems, Inc., Pasadena, Calif.
HYDROGEN-OXYGEN ELECTROLYTIC REGENERATIVE FUEL CELLS
John J. Rowlette 11 Nov. 1963 11 p
(Contract NAS3-2781)
(NASA-CR-57668; EOS-4110-M-3) CFSTI: HC $1.00/MF $0.50

The design for the prototype fuel cell was completed after a stress analysis based on the assumptions of a maximum working pressure of 400 psia, a test pressure for the casing of 600 psia, and a compression of the asbestos at 800 psia. Results led to enlargement of the radius for the end caps of the outer casing and an increase in the casing flange thickness. The total cell polarization while operating under conditions corresponding to the 750-nautical mile orbit, was tested on a single cell and showed better than expected characteristics with a midpoint of 1.50 for the experimental charging curve. Instrumentation for the orbital simulation is being assembled. Graphic presentations of the complete fuel cell battery assembly, the separator construction, and the oxygen end plate are included. G.G.

N65-20810*# Electro-Optical Systems, Inc., Pasadena, Calif.
HYDROGEN-OXYGEN ELECTROLYTIC REGENERATIVE FUEL CELLS
Harvey Frank 10 May 1964 7 p
(Contract NAS3-2781)
(NASA-CR-57669; EOS-4110-M-8) CFSTI: HC $1.00/MF $0.50

The rechargeable fuel cell assembly was modified by connecting a small steel container to the hydrogen side of the assembly to achieve the required 2 to 1 gas volume ratio. Installation of nylon-reinforced silicone bellows added pressure strength; installation of hydrogen electrodes which contained only platinum as catalyst minimized the possibility of internal ignition. The addition of more electrolyte to the asbestos matrices insured a sufficient water supply during high charge. The unit functioned very well in subsequent cycle testing for five cycles with a discharge output in excess of 75 watts, and a charge voltage of less than 10 volts for each period. An abnormal drop in voltage during the discharge of the sixth cycle indicated an internal short circuit of one of the cells. An internal ignition during the next test caused extrusion of the Teflon gasket and it was decided to change the gasket material to viton. A gas permeability study of the asbestos matrices indicated a strong correlation between the thickness, number of layers, and grade of the asbestos matrices. G.G.

N65-20811*# Electro-Optical Systems, Inc., Pasadena, Calif. Energy Conversion Div.
HYDROGEN-OXYGEN ELECTROLYTIC REGENERATIVE FUEL CELLS
Harvey Frank 10 Feb. 1964 6 p
(Contract NAS3-2781)
(NASA-CR-57671; EOS-4110-M-5) CFSTI: HC $1.00/MF $0.50

Physical work on the development of a rechargeable fuel cell centered on fabrication of the component parts of the nominal 75-watt model and on assembling the unit. Critical dimensions of all parts were checked and found to be within specified tolerances. The water-filled unit was proof tested at 500 psig for 1/2 hour by application of nitrogen gas without deformation of any parts. Operation in the quasi-secondary mode with six cells inside the assembly established the impedance of the complete assembly as 0.048 ohms at 37° C. The charge cycle was performed at design current and duration but, due to the off design temperature and reduced gas pressure, the discharge cycle was performed at below rated current to simulate the rated ampere-hours. Charge and discharge characteristics for a 6-cell unit are presented. G.G.

N65-20813*# Electro-Optical Systems, Inc., Pasadena, Calif.
HYDROGEN-OXYGEN ELECTROLYTIC REGENERATIVE FUEL CELLS

M. Klein 10 Oct. 1964 12 p
(Contract NAS3-2781)
(NASA-CR-57662; EOS-4110-ML-12) CFSTI: HC $1.00/MF $0.50

Continued single cell tests, including a 50-hour cycling test, were run on 10 cells. Electrode catalyst loading, asbestos mat type, and electrolyte to asbestos weight ratio were varied. Most cells showed good initial performance, but deteriorated with cycling. Some improvements were achieved by changes in catalyst loading and in mat types, but no cause or corrective solution was found for the problem of KOH consumption. Apparently, the KOH is being consumed by an impurity in the electrodes either as a result of reaction with some compound formed during the charging process, or with some impurity added during assembly. Components were received, inspected, and accepted for assembly of the six-cell module, and the new fuel cell test facility was completed. E.P.V.

N65-20830# Joint Publications Research Service, Washington, D. C.
NEW LIFE PNEUMOAUTOMATICS
A. Govorov 6 Apr. 1965 10 p Transl. into ENGLISH from Nauchno-Tekhn. Obshchestva SSSR (Moscow), no. 1, Jan. 1965 p 25–29
(JPRS-29454; TT-65-30660) CFSTI: $1.00

The construction and operation of universal systems of industrial pneumoautomatics are described. These consist of such simple elements as resistors, relays, capacitors, amplifiers, and other elements fully analogous to electronic devices except that they operate through air pressure. Printed circuit methods for constructing pneumatic devices permits production of both analog and discreet devices of any complexity with considerable time saving and high reliability. Detailed descriptions of a pneumorepeater, an operational amplifier, a pneumorelay, and an element memory cell are given; and the operation of a multichannel discrete regulator, whose working elements have a working frequency range of tens of cycles per second, is outlined. G.G.

N65-20863# Naval Ordnance Lab., White Oak, Md.
WIRED-TELEMETRY FLIGHT-TEST TECHNIQUE
L. J. Shkolnik 18 Aug. 1964 16 p ref Journal of the JANAF Fuze Comm., Serial No. 33
(AD-454840)

The wired-telemetry flight-test technique for recording fuze performance during the early part of rocket flight is described. This method was developed because rf telemetering techniques are subject to various forms of interference and often yield a poor signal-to-noise ratio. The technique described is generally applicable to any nonrotating vehicle exhibiting a gradual acceleration buildup as a flight characteristic. The work described herein was performed several years ago with both the 3-in. and 5-in. rockets. The rockets in use today, however, have velocities and accelerations considerably greater than were dealt with during these tests. The equipment described may require modification for use with the newer rockets.
Author

N65-20887*# Honeywell, Inc., Hopkins, Minn. Ordnance Div.
DESIGN, CONSTRUCTION, AND TESTING OF LOW INPUT VOLTAGE CONVERTERS (2.5-VOLT AND 0.6-VOLT) Summary Report
R. L. Carlson 23 Mar. 1965 53 p Prepared for JPL
(Contracts NAS7-100; JPL-951041)
(NASA-CR-57789) CFSTI: HC $3.00/MF $0.50

Two low input voltage converters were designed, constructed, and tested. They were designed to have the lowest weight and volume commensurate with the efficiency specifications. Both units met the efficiency specification and both units made significant reductions in weight and volume. The 2.5-volt unit is approximately one quarter of the specifications limits for weight and volume. The 0.6-volt system utilizes a new coaxial design and is one-half the weight and one-third of the volume specified as maximum. Illustrative photos of the 2.5-volt unit and the 0.6-volt system are shown. Author

N65-20892# Eagle-Picher Co., Joplin, Mo. Couples Dept.
INVESTIGATIONS LEADING TO THE DESIGN OF A RELIABLE SEALED NICKEL–CADMIUM CELL Final Report, 1 May 1963–30 Apr. 1964
Leroy Folks and C. O. Gosch 31 May 1964 46 p refs
(Contract DA-36-039-AMC-00135(E))
(Rept.-8; AD-460165)

The four experiments completed were the cycle life performance, self-discharge, charge acceptance, and overcharge acceptance experiments. The cycle life experiment produced these data: negative linear trend with increasing KOH concentration; type separator, type negative, 80% LiOH as additive. The self-discharge experiment showed positive linear trend with increasing KOH concentration, and type negative. The charge acceptance and overcharge acceptance experiments produced data which appear in this report. Author

N65-20955# Texas Instruments, Inc., Dallas.
EXTENDED MOLTEN-CARBONATE FUEL CELL SYSTEM PROGRAM Second Quarterly Progress Report, 24 Oct.–1 Jan. 1965
J. K. Truitt et al [1965] 36 p
(Contract DA-44-009-AMC-54(T))
(TI-08-65-07; AD-460354)

As part of a program for development of low-cost, compact fuel cell modules with molten-carbonate electrolytes, the design and reliability testing results are reported for seven candidate models. For each of the tested modules, voltage output at 15 and 30 watts/ft^2 was recorded at the front and rear cells for lifetimes up to 1000 hours; flow of hydrogen, nitrogen, and carbon dioxide at the anode, and of air at the cathode, were also observed. The overall molten-carbonate fuel system is discussed briefly. J.M.D.

N65-20966# Elliot Bros., Ltd., London (England). Space and Guided Weapons Div.
A COLD GAS ATTITUDE CONTROL FOR THE SKYLARK SOUNDING ROCKET PAYLOAD. STAGE I: SOLAR POINTING MISSION
3 Oct. 1964 102 p
(T(F)10)

The technical design factors for the solar pointing mission cold gas attitude control of the Skylark sounding rocket payload are described. The expected performance parameters await confirmation by flight trials. The Skylark sounding rocket and its attitude control interface problems are also discussed. The first flight was generally successful. The results of the trial flight are not included. E.E.B.

N65-20998*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PARAMETRIC STUDY OF A THERMOELECTROSTATIC GENERATOR FOR SPACE APPLICATIONS

Paul M. Margosian Washington, NASA, Apr. 1965 48 p refs (NASA-TN-D-2763) CFSTI: HC $2.00/MF $0.50

Examined in this report is the theoretical performance of a thermoelectrostatic generator—a variable capacitance device capable of converting thermal energy directly to electrical energy. Two physically realizable thermodynamic cycles were selected. Two dielectric materials, barium titanate and polyethylene terephthalate, were selected for their potential ability to yield the best performance attainable with this device. Mathematical expressions for internal energy and entropy in terms of electrical and thermodynamic parameters were derived. Mathematical approximations to the behavior of the dielectric constants of the materials were chosen. Equations describing the thermodynamic cycles were derived and solved numerically. The upper limits on performance were found to be the following: maximum thermal efficiency, 1% to 4%; and maximum energy output, 0.5 to 1.5 joules per cubic centimeter of dielectric per cycle. Realistic performance, dictated by material properties and limitations on the electric field that can be supported, is lower by at least a factor of five. Author

N65-21024# Army Electronics Labs., Fort Monmouth, N. J.
UNSYMMETRICAL WAVEFORM THERMIONIC DIODE AND SYSTEMS STUDY
Joseph P. Angello Jan. 1965 28 p refs
(ECOM-2547; AD-612798)

The operation of a pulsed, cesium vapor-type thermionic diode is analyzed as an unsymmetrical waveform generator. The characteristics of the diode in this mode are investigated to determine the optimum duty cycle ratio of on–off time, and to establish the requirements for the switching circuitry and power transformer. The system approach being taken, for raising the low voltage power of a diode to meet the impedance requirements of most equipment, may have advantages over a system employing a large number of diodes connected electrically in series. Author

N65-21086*# Bendix Corp., South Bend, Ind. Bendix Products Aerospace Div.
ELECTROPNEUMATIC LINEAR GIMBAL ACTUATION SYSTEM, MODEL NV-BI, 29 JUNE 1963–29 JUNE 1964
B. S. Hegg 1 Aug. 1964 260 p
(Contract NAS8-5407)
(NASA-CR-57843; BPAD-864-15479) CFSTI: HC $6.00/MF $1.50

The prime intent of this program was to prove the feasibility of an electropneumatic linear actuator for thrust vector control. The actuator was designed with all possible component safety factors to insure satisfactory operation; therefore, size and weight specifications were considered secondary for this prototype design. The design, development and tests proved feasibility of the use of an electropneumatic actuator for thrust vector control. Testing reported indicates that improved performance of the design is attainable by further development of various components. Size and weight requirements of the specification may also be satisfied using the basic design proven under this program. Author

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; protective clothing and equipment; physiological and psychological factors. For related information see also: 05 Biotechnology.

N65-20132# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS FROM VESTNIK MOSKOVSKOGO UNIVERSITETA (HERALD OF MOSCOW UNIVERSITY), 6TH SERIES, NO. 1 AND 6, 1964
15 Mar. 1965 49 p refs Transl. into ENGLISH of 5 articles from Vestn. Mosk. Univ. (Moscow), ser. 6, no. 1–6, Jan.–Feb., Nov.–Dec., 1964
(JRRS-29112; TT-65-30508) CFSTI: $2.00

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N65-20133 Joint Publications Research Service, Washington, D. C.
THE STUDY OF ELECTRIC RESISTANCE AND AUTOLYSIS OF THE SPLEEN TISSUE OF IRRADIATED ANIMALS
Ye. V. Burlakova and M. L. Kakushkina *In its* Transl. from Vestn. Mosk. Univ. (Herald of Moscow Univ.), 6th ser., no. 1 and 6, 1964 15 Mar. 1965 p 19–25 refs (See N65-20132 10-04) CFSTI: $2.00

The change in electric conductivity and the rate of autolysis of spleen tissue of normal animals and animals irradiated with gamma-rays revealed an increase of low-frequency resistance in the spleen tissue upon prolonged survival. A correlation ratio of 0.89 was found for the increase in low-frequency resistance and the autolysis intensification of the spleen of irradiated rats. This correlation ratio was considered statistically significant and is similar to the correlation of the same processes observed in surviving liver tissue. E.E.B.

N65-20138 Joint Publications Research Service, Washington, D. C.
CHEMICAL PROTECTIVE DRUGS AGAINST IONIZING RADIATION
Ch'i-chick Hsiao *In its* Transl. on Communist China's Sci. and Technol., No. 161 19 Mar. 1965 p 96–105 refs Transl. into ENGLISH from Yao-hsueh T'ung-pao (China), v. 10, no. 8, Aug. 1964 p 337–341 (See N65-20134 10-34) CFSTI: $4.00

A survey of drugs proven effective against ionizing radiation is presented, and their degree of effectiveness discussed. These include sulfurated amino acids, mercaptoalkylamines, thiocarbamide derivatives, thiozolidine aminoalkylthiosulfates, aminodithioformic acids, sulfoxides, and other sulfides. Also discussed are amino acids and amines without sulfur; substances that create lack of oxygen, such as p-aminopropiophinone, sodium nitrate, methylene blue, potassium chlorate, the cyanides, nitriles, oxides, pyrogallic acid, and certain ketone derivatives; chelate compounds; certain vitamins; Rauwolfia alkaloids; and ozone. G.G.

N65-20139# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS FROM BYULLETEN' EKSPERIMENTAL' NOY BIOLOGII I MEDITSINY (BULLETIN OF EXPERIMENTAL BIOLOGY AND MEDICINE), VOLUME 59, No. 1, 1965
23 Mar. 1965 35 p refs Transl. into ENGLISH of selected articles from Byull. Eksptl. Biol. i Med. (Moscow), v. 59, no. 1, Jan. 1965
(JPRS-29250; TT-65-30569) CFSTI: $2.00

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3. IMMUNO-PHYSIOLOGICAL CHANGES IN HOMOTRANSPLANTATION OF EXTREMITIES IN CANINES N. A. Barbarash p 14–19 refs

4. BONE MARROW TRANSPLANTATION IN RATS WITH M-1 SARCOMA AFTER TREATMENT WITH TOXIC THIOTEP DOSES G. M. Sukhin p 20–26 refs

5. DAILY RHYTHM OF MITOTIC ACTIVITY IN THE REGENERATING LIVER DURING ACUTE RADIATION SICKNESS V. I. Bulgak p 27–32 refs (See N65-20142 10-04)

N65-20140 Joint Publications Research Service, Washington, D. C.
RATE OF NYSTAGMIC FAST COMPONENT PRODUCED BY RHYTHMIC ELECTRICAL STIMULATION OF THE AMPULLAR RECEPTOR
M. M. Levashov *In its* Transl. from Byull. Eksptl. Biol. i Med. (Bull. of Exptl. Biol. and Med.), Vol. 59, No. 1, 1965 23 Mar. 1965 p 1–8 refs (See N65-20139 10-04) CFSTI: $2.00

Data are presented which show that in experiments where nystagmic reactions were obtained in the frequency range of stimulation, an optimum frequency was found for the fast component of the vestibular nystagmus. The experiments were conducted on adult rabbits, and details of the methods employed are given. E.E.B.

N65-20141 Joint Publications Research Service, Washington, D. C.
EFFECT OF IONIZING RADIATION ON THE NEUROSECRETION OF NUCLEI IN THE HYPOTHALAMIC AREA
L. A. Andrianova *In its* Transl. from Byull. Eksptl. Biol. i Med. (Bull. of Exptl. Biol. and Med.), Vol. 59, No. 1, 1965 23 Mar. 1965 p 9–13 refs (See N65-20139 10-04) CFSTI: $2.00

Male rabbits were subjected to Co^{60} gamma radiation at the rate of 248 R/min for a total dose of 400 R. When sections of the brain of the control animals were treated with aldehyde–fuchsin, a slight content of a neurosecretory substance was indicated. In irradiated animals studied 2 hours after irradiation, an increase of the neurosecretion was observed. In irradiated animals studied 24 hours after irradiation, a tendency toward the normalization of the neurosecretion was revealed, and in some nuclei it disappeared completely after 72 hours. Initially, after irradiation, a change in the excitability and an increase in bioelectric activity were characteristic of the hypothalamic centers. E.E.B.

N65-20142 Joint Publications Research Service, Washington, D. C.
DAILY RHYTHM OF MITOTIC ACTIVITY IN THE REGENERATING LIVER DURING ACUTE RADIATION SICKNESS
V. I. Bulgak *In its* Transl. from Byull. Eksptl. Biol. i Med. (Bull. of Exptl. Biol. and Med.), Vol. 59, No. 1, 1965 23 Mar. 1965 p 27–32 refs (See N65-20139 10-04) CFSTI: $2.00

The daily mitotic rhythm in regenerating liver cells during acute radiation sickness of male albino rats weighing 200 to 250 grams is reported. The left lateral and central hepatic lobes were removed in aseptic conditions under ether anesthesia. The change in mitotic activity, binuclear cells in a regenerating liver of nonirradiated and irradiated rats, and percentage correlation of mitotic phases in regenerating liver at different hours of the day are tabulated. It was impossible to discover any regularity which would confirm the presence of daily variations in the number of binuclear cells of nonirradiated and irradiated rats. E.E.B.

N65-20198# Osterreichische Studiengesellschaft für Atomenergie G.m.b.H, Seibersdorf (Austria). Reaktorzentrum Seibersdorf
ABOUT METAL IONS BONDING TO NUCLEIC ACIDS [UBER DIE BINDUNG VON METALLIONEN AND NUKLEINSAUREN]
H. Altmann, H. Kaindl, H. Frischauf, and K. Kaindl 1964 7 p refs In GERMAN
(SGAE-BL-14)

The bonding of Cu^{++}, Ni^{++}, Zn^{++}, Mn^{++}, and Ca^{++} to nucleic acids of the human spleen was investigated, and different affinities for the various metals were established. The Ca^{++} and Mn^{++} ions formed preferred bonds with the phosphate groups of the nucleic acids. Zn^{++} and Cu^{++} showed a very low affinity, and Ni^{++} ions had no specific bonding affinity to the nucleic phosphates. The activity of the introduced copper and zinc ions was most noticeable in the phenol phase of the protein residue. Trans. by G.G.

N65-20324* George Washington Univ., Washington, D. C.
RUSSIAN LIFE IN SPACE
Josiah W. Tyson *In its* The George Washington Univ. Mag. 1965 p 6–9 (See N65-20322 10-34) CFSTI: HC $2.00/MF $0.50

Biodynamics, which embraces all of those experimental procedures examining the effects of physical stresses on organisms, is discussed. The plants, animals, and materials used in the U.S.S.R. space biology program are tabulated. The Russian interest in psychobiological behavioral studies with animals is summarized. Their use of dogs is understandable in view of their long experience in the use of dogs by Pavlov and others. E.E.B.

N65-20372# Federal Aviation Agency, Washington, D. C. Library Services Div.
AVIATION MEDICAL PAPERS AND REPORTS—A BIBLIOGRAPHY
Oct. 1964 94 p
(AM-64-20)

N65-20395 Library of Congress, Washington, D. C. Aerospace Technology Div.
SOVIET RESEARCH ON PHOTOSYNTHESIS

In its Foreign Sci. Bull., Vol. 1, No. 1, Jan. 1965 [1965] p 23–29 refs (See N65-20390 10-34)

A review is presented of basic trends in the Soviet approach to the problems of photosynthesis. Considered is the photosynthetic ability of plants as a process which undergoes adaptations to long-range changes in environmental conditions and which is modified in vivo in the process of evolution according to the availability of natural reducing agents which function as electron (hydrogen) donors in photosynthesis. The concept of differing redox potential levels in a photosynthesizing system is taken as a basis for planning and actual testing of various model systems, e.g., those with pyridine nucleotides and higher-plant and bacterial pigments combined into pairs. In a discussion of the photoexcitation and energy-transfer mechanism, the possibility of a two-quanta process is considered. The results obtained in model systems seem to agree with the known evolutionary concepts. Author

N65-20471*# Texas Inst. for Rehabilitation and Research, Houston.

THE EFFECT OF BEDREST ON VARIOUS PARAMETERS OF PHYSIOLOGICAL FUNCTION. PART III: BIOINSTRUMENTATION

F. W. Vogt, R. J. Lamonte, J. R. Mc Connell, T. O. Hallen, C. Vallbona et al Washington, NASA, Apr. 1965 15 p refs (Contract NAS9-1461)

(NASA-CR-173) CFSTI: HC $1.00/MF $0.50

A bioinstrumentation system for collecting and recording multiple cardiovascular measurements was developed for use in tilt-table tests and for bedside monitoring during bedrest studies. Each component unit of the system is discussed. Author

N65-20472*# Texas Inst. for Rehabilitation and Research, Houston.

THE EFFECT OF BEDREST ON VARIOUS PARAMETERS OF PHYSIOLOGICAL FUNCTION. PART VII: CARDIAC AND VENTILATORY RESPONSE TO THE BICYCLE ERGOMETER TEST

D. Cardus, W. A. Spencer, C. Vallbona, and F. B. Vogt Washington, NASA, Apr. 1965 22 p refs

(Contract NAS9-1461)

(NASA-CR-177) CFSTI: HC $1.00/MF $0.50

A study on effects of 14 days bed rest on tolerance to physical work was carried out on 6 healthy subjects. Tolerance was tested with the bicycle ergometer. Oxygen consumption, CO_2 production, pulmonary ventilation, breaths per minute, and frequency of the heart at different work loads, and recovery time of heart rate after cessation of exercise were measured. Results indicate that changes observed after 14 days bed rest in respiratory gas exchange, ventilation, and mechanical efficiency were not significant; heart rate at rest and during exercise was significantly higher after 14-days bed rest. Isometric exercises carried out in a second 14-day bed rest period did not completely prevent the observed changes in heart rate. Author

N65-20473*# Texas Inst. for Rehabilitation and Research, Houston.

THE EFFECT OF BEDREST ON VARIOUS PARAMETERS OF PHYSIOLOGICAL FUNCTION. PART XI: THE EFFECT OF BEDREST ON BLOOD VOLUME, URINARY VOLUME, AND URINARY ELECTROLYTE EXCRETION

F. B. Vogt, W. A. Spencer, D. Cardus, and C. Vallbona Washington, NASA, Apr. 1965 31 p refs

(Contract NAS9-1461)

(NASA-CR-181) CFSTI: HC $2.00/MF $0.50

Seven subjects participated in 14-day bed rest studies using controlled diets and careful measurement of intake and output. A 14-day bed rest period was followed by a 14-day recovery period, which in turn was followed by a second 14-day bed rest period to which was added an exercise program. A diuresis and naturesis was observed with bed rest. Day to day variation in plasma volume determination makes interpretation of this measurement difficult. Author

N65-20474*# Texas Inst. for Rehabilitation and Research, Houston.

THE EFFECT OF BEDREST ON VARIOUS PARAMETERS OF PHYSIOLOGICAL FUNCTION. PART XII: THE EFFECT OF BEDREST ON BONE MASS AND CALCIUM BALANCE

F. B. Vogt, P. B. Mack, W. G. Beasley, W. A. Spencer, D. Cardus et al Washington, NASA, Apr. 1965 54 p refs

(Contract NAS9-1461)

(NASA-CR-182) CFSTI: HC $3.00/MF $0.50

Seven subjects participated in 14-day bed rest studies using approximately 1.0 g calcium diets. A 14-day bed rest period was followed by a 14-day recovery period, which in turn was followed by a second 14-day bed rest period to which was added an isometric exercise program. The exercise program appeared to prevent the loss of bone density which occurred in the bed rest without exercise period. Calcium balance results are difficult to interpret because of short control periods to attain an equilibrium to the test conditions. Author

N65-20526# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center

THE EFFECT OF PULSATING LIGHT SOURCES ON THE ELECTRICAL ACTIVITY OF THE HUMAN BRAIN

V. A. Il'yanok and V. G. Samsonova Feb. 1965 13 p refs Transl. into ENGLISH from Svetotekhnika USSR, (Moscow), v. 5, 1963 p 1–5

(RSIC-298; AD-611773)

During stimulations by rhythmic light, a change in the frequency spectrum of the EEG is observed as a drastic increase in the amplitudes of frequencies imposed upon and reproduced by the brain, and a decrease in all other frequencies. The spectrum of the EEG in a wide range of frequencies, and its changes at various frequencies, intensities, and durations of rhythmic light flashes, as well as during the simultaneous action of two or more light rhythms differing in frequencies were studied. Experiments were conducted using a photostimulator which provided a practically rectangular form of light pulses with frequencies ranging from 3 to 240 cps. Exposure of the pupil to the screen viewed at an angle of 95° varied from 0.08 to 250 lux and lasted 50 seconds. Results showed that the maximum limit of frequencies reproduced by the brain was not of stabilized intensities but depended on the individual features of each brain, as well as on the intensities of light stimulations, and the duration of the light impulses. E.W.

N65-20566# Imperial Coll. of Science and Technology, London (England). Botany Dept.

PHOTOSYNTHETIC MECHANISMS UNDER SUB-OPTIMAL CONDITIONS Final Scientific Report

C. P. Whittingham 21 Oct. 1964 18 p refs

(Grant AF-EOAR-64-1)

(AFOSR-65-0056; AD-610161)

The hypothesis that part of the sucrose formed in photosynthesis is derived through a 2-carbon pathway, with glycollate as an intermediate product, was tested under laboratory

conditions. Sucrose degradation was studied in Chlorella and algal samples, to see whether the molecular labeling patterns underwent change. Results showed that glucose is not metabolized to carbon dioxide and reformed in photosynthesis; relative predominance of glycollate appeared to be effected by photosynthetic conditions. It was concluded that sucrose formed in the experiments did not show changes in labeling pattern which would be consistent with formation of sucrose from glycollate. J.M.D.

N65-20588 Joint Publications Research Service, Washington, D. C.
EXPERIMENTS ON FISH OVULATION INDUCED BY STEROIDS
Chang Hsing, Hsiang-hsiung Li, and Tzu-i Chang. *In its* Transl. on Communist China's Sci. and Technol., No. 162 23 Mar. 1965 p 33–38 refs Transl. into ENGLISH from K'O-hsueh T'ung pao (Peking), no. 1, 1965 p 79-81 (See N65-20582 10-34) CFSTI: $2.00

Artificial stimulation of ovulation in fish and the effects of steroids, especially progesterone and suprarenal cortin, in the ovulating cycle are reported. Results supported the theory that there is an interrelationship between the suprarenal gland cortin and ovulation, as there is between ovulation and stress reactions. It was shown that progesterone promotes the maturing of ova and ovulation. The experiments also explained the complementary action of pituitrin and cortin. Also, the economics of using corticosteroids for promotion of fish ovulation was discussed. E.E.B.

N65-20599# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS FROM MEDITSINSKAYA RADIOLOGIYA (MEDICAL RADIOLOGY), VOLUME IX, NO. 12, 1964
B. P. Kalashnikov et al 2 Apr. 1965 60 p refs Transl. into ENGLISH from Med. Radiol. (Moscow), v. 9, no. 12, 1964 (JPRS-29410; TT-65-30641) CFSTI: $3.00

CONTENTS:

1. RADIOISOTOPIC DIAGNOSIS OF EYE TUMORS AND WAYS OF ITS IMPROVEMENT B. P. Kalashnikov and Yu. A. Bystrova p 1–12 refs

2. PROBLEMS OF RADIATION HYGIENE IN ISOTOPIC MYELORADIOMETRY N. I. Nikberg and V. Kh. Frenkel' p 13–19 refs

3. RADIATION INJURY DURING IRRADIATION OF VARIOUS PARTS OF THE HEAD Yu. D. Skoropad p 20–28 refs

4. THE COURSE OF RADIATION SICKNESS AGAINST THE BACKGROUND OF THE STIMULATING ACTION OF RADIOPROTECTIVE AGENTS ON THE HYPOPHYSIO-ADRENAL SYSTEM V. Ye. Ryzhenkov and A. M. Stashkov p 29–35 refs

5. THE MECHANISM OF PROTECTIVE EFFECT OF NIBUPHIN ON THE HEART IN ACUTE RADIATION SICKNESS IN RATS B. S. Berezovskiy and I. V. Zaikonnikova p 36–40 refs

6. THE RADIORESISTANCE AT VARIOUS STAGES OF ACUTE RADIATION SICKNESS I. G. Akoyev p 41–49 refs

7. THE EFFECT OF IRRADIATION ON THE VASCULAR PERMEABILITY AND MUCOPOLYSACCHARIDE AND SEROTONIN LEVELS IN THE BLOOD G. A. Chernov, Z. I. Sheremet, and R. V. Lenskaya p 50–57 refs

N65-20625*# California Univ., Berkeley. Space Sciences Lab.
ENZYME ACTIVITY IN TERRESTRIAL SOIL IN RELATION TO EXPLORATION OF THE MARTIAN SURFACE Semi-annual Progress Report, 1 Jul. 1964–1 Feb. 1965
J. O. Falkinham, J. Skujins, and A. D. Mc Laren 9 Mar. 1965 65 p refs *Its* Ser. No. 6, Issue No. 8
(Grant NsG-704)
(NASA-CR-57585) CFSTI: HC $3.00/MF $0.75

Three studies whose objective is to develop qualitative tests for the various enzyme activities in soil and to adapt the most sensitive of these to procedures compatible with radiotelemetry from the Moon and Mars are reported. The first is a survey of the biochemistry of terrestrial soils with special emphasis on possible applications to detection of extraterrestrial life, prelife, or evidence of extinct life. The second is a survey of the enzymes found in terrestrial soils, the reactions they catalyze, and the methods of determining their activities. The soils examined all exhibited significant levels of substrate degradation, so modifications of the techniques used in enzyme assays to fit a Martian life probe are being evaluated. The third study reports initial results regarding urease activity in saturated urea solutions in preparation for urease measurements in soil, and also the results of a literature survey on the subject. Urease determination using C^{14} labeled urea as the substrate is discussed, as well as the design of a self-contained $C^{14}O_2$ counting chamber and the development of a solid-state radiation detector. M.P.G.

N65-20753*# Litton Systems, Inc., St. Paul, Minn. Applied Science Div.
MARS BIOLOGICAL SAMPLE COLLECTION AND PROCESSING STUDY PROGRAM Final Report, 15 Nov. 1963–31 Dec. 1964
D. A. Lundgren, V. W. Greene, and M. J. Grundtner 1 Feb. 1965 183 p ref Prepared for JPL *Its* Rept.-2703
(Contracts NAS7-100; JPL-950771)
(NASA-CR-57724) CFSTI: HC $5.00/MF $1.25

The following sample acquisition and biological support studies are discussed: description of soil samples, and of analytical techniques; evaluation of microbial assay techniques, detection criteria, and sampling techniques and concepts; processing studies; and related biological experiments. Results are summarized and recommendations made. An appendix pertaining to sample acquisition as a problem in exobiological research contains a brief review of the existing interfaces between sampling and life detection, followed by more detailed discussions of the biological, mechanical, and statistical considerations involved. G.G.

N65-20828# Joint Publications Research Service, Washington, D. C.
RADIOLYSIS OF A DEXTRAN-DERIVED BLOOD-PLASMA SUBSTITUTE AND EFFECT OF Co^{60} ON MUSCLE ATP AND INORGANIC PHOSPHORUS
S. V. Markevich et al 18 Mar. 1965 19 p refs Transl. into ENGLISH of 2 articles from Vestsi Akad. Navuk Belarusk. SSR, Ser. Biyal. Navuk (Minsk), no. 3, 1964 p 107–118 (JPRS-29183; TT-65-30541) CFSTI: $1.00

CONTENTS:

1. RADIOLYSIS OF POLYGLUCIN SOLUTION S. V. Markevich, S. S. Kharamonenko, P. Te. Gorbunov, Ya. V. Stakhovskiy, A. I. Valakhanovich et al p 1–9 refs

2. ACTION OF RADIOACTIVE COBALT (Co^{60}) ON THE CONTENT OF ADENOSINETRIPHOSPHORIC ACID AND ACID-SOLUBLE INORGANIC PHOSPHORUS IN THE CARDIAC AND SKELETAL MUSCLES OF RATS N. M. Labanova p 10–16 refs

N65-20829# Joint Publications Research Service, Washington, D. C.

ON THE PHYSIOLOGICAL MECHANISM OF THE EFFECT OF WEIGHTLESSNESS ON THE ORGANISM OF MAN

I. I. Kas'yan and V. I. Kopanev 5 Apr. 1965 14 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Biol. (Moscow), no. 1, Jan.–Feb. 1965 p 10–17

(JPRS-29433; TT-65-30652) CFSTI: $1.00

Generalized scientific data on the physiological reactions of animals and of man under conditions of weightlessness are discussed and evaluated in an attempt to define their mechanisms. The observed sensory, motor, and vegetative disruptions of the organism's functions are attributed to the reduction of the weight of the tissues and organs and consequently the change in signaling from the receptors, resulting in reduced blood pressure, an accumulation of blood in the venous channels, probable diminished venous blood circulation from the upper part of the body, changes in the biomechanics of external breathing, and interruption of motion coordination. The averaged effect of weightlessness is considered as a consequence of the change of the functional state of the central nervous system, and the cooperative work of the analyzers. G.G.

N65-20831# Joint Publications Research Service, Washington, D. C.

NEW FRONTIERS OF SPACE MEDICINE

6 Apr. 1965 17 p Transl. into ENGLISH of 4 articles from Med. Gazeta (USSR), 16 Oct. 1964 p 3

(JPRS-29456; TT-65-30662) CFSTI: $1.00

CONTENTS:

1. ABOARD THE "VOSKHOD" Ye. Zab'yalov and V. Popov p 1–5
2. A UNIQUE EXPERIMENT IN OUTER SPACE I. Khazen and F. Kosmolinskiy p 6–10
3. FEEDING IN FLIGHT p 11–12
4. EXTRATERRESTRIAL LIFE AND TERRESTRIAL SCIENCE p 13–14

N65-20832# Joint Publications Research Service, Washington, D. C.

THE LIMITS OF DIFFERENTIATED INHIBITION

Ye. G. Guseva 6 Apr. 1965 13 p refs Transl. into ENGLISH from Zh. Vysshei Nervnoi Deyatel'nosti (Moscow), v. 14, no. 4, 1964 p 687–694

(JPRS-29461; TT-65-30667) CFSTI: $1.00

A study of the dynamics of the limits of differentiation inhibition by gradual increase in the physical strength of inhibitory stimulation has shown that the threshold of inhibition began, in dogs, with disinhibition of differentiation. However, another phenomenon was also observed, where there was no disinhibition; on the contrary, when the intensity of the inhibitory stimulus was increased, there was a decrease in salivation in response to the inhibitory stimulus. At first, the absence of disinhibition when the physical strength of the inhibitory stimulus was increased was considered to be a coincidental phenomenon, but with accumulation of experimental data it became obvious that its appearance followed a visible pattern; it was observed in 4 of 12 dogs. Author

N65-20833# Joint Publications Research Service, Washington, D. C.

MECHANISMS OF GENERAL COMPLICATIONS ENSUING FROM THERMAL INJURIES

B. A. Saakov 8 Apr. 1965 23 p Transl. into ENGLISH from the book "Mekhanizmy Obshchikh Oslozhneniy Termicheskikh Travm" Kiev, Gosmedizdat p 259–276

(JPRS-29494; TT-65-30683) CFSTI: $1.00

Results of a literature survey and experimental investigation of the injurious effect of thermal traumas and ensuing pathological processes on the organism are reported. The role of functional disorders of the nervous system in the pathogenesis of burn shock, hyperthermia, and hypothermia was established, using the electrophysical method. E.P.V.

N65-20834# Joint Publications Research Service, Washington, D. C.

IMPORTANT EXPERIMENTS IN OUTER SPACE

Boris Yegorov 9 Apr. 1965 8 p Transl. into ENGLISH from Aviats. i Kosmonavt. (Moscow), no. 12, Dec. 1964 p 34–38

(JPRS-29521; TT-65-30700) CFSTI: $1.00

The Russian physician-astronaut describes his own and his crew's biocurrent recordings during orbit. Observed were electrocardiograms, respiratory movements of the chest, seismocardiograms, electrical potentials of the brain appearing during voluntary and involuntary eye movements, parameters characterizing coordination of movements during tracing of figures and letters, a curve characterizing muscular efficiency in performing rhythmic motions of the hand, frequency of pulse and breathing, arterial pressure, gas interchange, and other phenomena. Instrumental methods of investigation were combined with observations to determine the condition of the astronauts. The sense of sight during flight was not changed but maximal arterial pressure was lowered under weightlessness conditions with no change in the minimum pressures. Certain variations in the morphological structure of the blood, in the water–salt exchange, etc., were of a transient and nonspecific nature. G.G.

N65-20835# Joint Publications Research Service, Washington, D. C.

SEMINAR: SOME PROBLEMS OF BIOCYBERNETICS AND THE APPLICATION OF ELECTRONICS IN BIOLOGY AND MEDICINE

K. A. Ivanov-Muronskiy and V. G. Mel'nikov 5 Apr. 1965 28 p refs Transl. into ENGLISH from the publ. "Seminar, Nekotoryye Probl. Biokibernetiki i Primeneniye Elektron. v Biol. i Med." Kiev, 1964 p 3–33

(JPRS-29435; TT-65-30654) CFSTI: $2.00

Electronarcosis and its use in medical practice were studied experimentally. The concept of anesthesia induction by electrical current is discussed in detail. Tests were done on dogs to determine the effects of electronarcosis on respiratory and cardiovascular systems, and on brain tissue, and the conclusion was that electronarcosis is not permanently harmful if used under certain well-defined conditions. Electronarcosis was successfully used on two patients. Based on these results an instrument was designed to create anesthesia through application of FM signals in such a way as to avoid tactile irritation and seizures. Another method was then devised, which was based on pulsations arising under influence of interference of high-frequency current, and which was then used in surgery on human cancer; this interference-electronarcosis technique was concluded to be the best of the present methods. J.M.D.

N65-20895# Aerospace Medical Div. Aeromedical Research Lab. (6571st), Holloman AFB, N. Mex.

CHIMPANZEE SERUM BIOCHEMIC ALTERATIONS DURING AND FOLLOWING 24 HOURS OF RESTRAINT Interim Report, Nov. 1961–May 1963

Ralph A. Scott, Jr. Oct. 1964 26 p refs
(ARL-TR-64-12; AD-457895)

Chimpanzee response to 24 hours of restraint was measured by biochemical serum alterations. Serum values in blood drawn immediately before, immediately after, 24 hours post-, and for a limited number of cases, 7 days postrestraint, are compared. The values are analyzed for significant deviations in relation to age, sex, and duration of restraint. The most pronounced changes with restraint occurred in potassium, inorganic phosphate, and total cholesterol. Author

N65-20896# Aerospace Medical Div. Aeromedical Research Lab. (6571st), Holloman AFB, N. Mex.
CHIMPANZEE HEMATOLOGIC ALTERATIONS DURING AND FOLLOWING 24 HOURS OF RESTRAINT Interim Report, Nov. 1961–May 1963
Ralph A. Scott, Jr. Oct. 1964 16 p refs
(ARL-TR-64-13; AD-458350)

Chimpanzee response to 24 hours of restraint was measured by determining hematologic alterations in blood drawn immediately before, immediately after, and 24 hours postrestraint. The values are analyzed for significant deviations in relation to age, sex, and duration of restraint. Pronounced alterations with restraint occurred in most of the formed elements determined. The formed elements of the blood support a hypothesis that a state of dehydration exists during restraint. Author

N65-20897# Aerospace Medical Div. Aeromedical Research Lab. (6571st), Holloman AFB, N. Mex.
CHIMPANZEE URINE BIOCHEMIC ALTERATIONS DURING 24 HOURS OF RESTRAINT Interim Report, Nov. 1961–May 1963
Ralph A. Scott, Jr. Oct. 1964 20 p refs
(ARL-TR-64-14; AD-458366)

Chimpanzee response to 24 hours of restraint was measured by alteration in urine biochemical values. Values in four consecutive 6-hour urine collections are compared. The values are analyzed for significant deviations in relation to age, sex, urine volume, and duration of restraint. The most pronounced changes with restraint occurred in urine potassium, chloride, epinephrine, total catechol amines, 17-ketosteroids, and in the urine volume. Author

N65-20981*# California Univ., Los Angeles. Brain Research Inst.
EFFECT OF SPACE ENVIRONMENT ON CIRCADIAN RHYTHMS OF PLANTS, FOR THE PURPOSE OF DEFINING AND VERIFYING AN EXPERIMENT SUITABLE FOR USE IN A BIOSATELLITE Semiannual Report, Sep. 1, 1963–Mar. 1, 1964
J. D. French and T. Hoshizaki 1 Mar. 1964 9 p
(Grant NsG-528)
(NASA-CR-53457) CFSTI: HC $1.00/MF $0.50

The previous findings on pinto bean leaf movements were confirmed. Time lapse recording has shown that there are no significant changes in the rhythmicity of the detached leaf from that of leaves attached to whole plants. Under greenhouse conditions, detached leaves which were rooted in vermiculite have been transplanted and grown in potting soil for as long as 6 weeks. Neuropora has been cultured on a low nutritional media. A reduction of growth rate of 1/2 inch to 3/4 inch per day was accomplished when specimens were placed in a constant temperature of 20° C. A 2-pound biopack was developed for orbital flight. The biopack is 2 1/2 inches in diameter and 7 inches long. Simulated orbital runs have been made with the biopack. E.E.B.

N65-21039# Mayo Clinic, Rochester, Minn.
BLOOD OXYGEN CHANGES INDUCED BY FORWARD (+ G_x) ACCELERATION Technical Report, 1 Apr. 1962–1 Nov. 1964
Natalio Banchero, Lucille Cronin, A. Clark Nolan, and Earl H. Wood Wright-Patterson AFB, Ohio, AMRL, Dec. 1964 23 p refs
(NASA Order R-43; Contract AF 33(657)-8899; Grants NIH G-H-3532; AHS-CI-10)
(AMRL-TR-64-132; AD-613331)

Six dogs under morphine–pentobarbital anesthesia were exposed to forward accelerations of 2, 4 and 6G for 1 minute and 6G for 3 minutes while in the horizontal, 15° head-up 15° head-down positions breathing room air. Exposures to 6G were repeated breathing 99.6% oxygen. Oxygen saturation and opacity at 800 millimicrons of blood were recorded continuously by cuvette oximeters. Pulmonary arterial-venous shunting was estimated from blood oxygen saturations. No systematic changes in femoral artery oxygen saturation occurred at 2G, while a 4% decrease was observed at 4G. Decreases occurred at 6G averaging 11% at the end of the 60-second exposure. Return to control (1G) values was nearly complete 50 seconds after the exposure. Oxygen inhalation delayed but did not prevent the desaturation. These decreases are believed due to pulmonary arterial-venous shunting. The average increase in pulmonary arterial-venous shunt over 1G values estimated at the end of 60-second exposures to 6G when breathing air, was 17%. Values for shunts at 6G, when breathing oxygen, were similar. Author

N65-21059# Naval Air Engineering Center, Philadelphia, Pa. Aerospace Crew Equipment Lab.
METABOLIC MECHANISMS OF MAN IN THE FULL PRESSURE SUIT. PHYSIOLOGICAL COST OF DONNING A FULL PRESSURE SUIT
Edwin Hendler, Donald W. Dery, and Neil Miller 1 Dec. 1964 25 p refs
(NAEC-ACEL-527; AD-609937)

Experienced subjects donned a full pressure suit under conditions of time and donning space limitations. Direct and indirect measures of physiological cost were made using oxygen consumption and heart rate, respectively. Approximately 1 kcal of energy per kg of body weight was expended in the donning task. Donning volumes as small as about 7 times the volume of the subject's body accommodated the dressing procedure with no apparent increases in donning time nor in energy expenditure. Suit fit was found to have an important effect on both effort and time required for donning. Author

N65-21073# Argentina. Comision Nacional de Energia Atomica, Buenos Aires.
RADIOPHOSPHORUS METABOLISM IN THE STATE OF ORTHOPHOSPHATE AND PYROPHOSPHATE IN *CHLORELLA VULGARIS* [METABOLISMO DEL RADIOFOSFORO AL ESTADO DE ORTOFOSFATO Y PIROFOSFATO POR LA *CHLORELLA VULGARIS*]
Leopoldo J. Anghileri 1964 8 p refs In SPANISH *Its* Informe No. 126

Chlorella vulgaris was cultured in media containing orthophosphorus and pyrophosphorus. Glucose was added to some of the cultures to determine its influence on the algae's phosphorus absorption. The phospholipid fractions from the pyrophosphorus medium containing glucose absorbed half as much as the culture without glucose. The orthophosphorus medium extracts contained more. An interesting observation is that in the presence of glucose and in a pyrophosphorus medium, the DNA is considerably reduced. R.N.A.

05 BIOTECHNOLOGY

Includes life support systems, human engineering, crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N65-21074# Argentina. Comision Nacional de Energia Atomica, Buenos Aires.

THE METABOLISM OF PHOSPHOR IN *CHLORELLA VULGARIS*. I: INCORPORATION OF P-32 BY LIPID FRACTION UNDER HETEROTROPHIC CONDITIONS [METABOLISMO DEL FOSFORO POR LA *CHLORELLA VULGARIS*. I: INCORPORACION DE P-32 A LA FRACCION LIPIDOS EN CONDICIONES HETEROTROFICAS]

Leopoldo J. Anghileri 1964 12 p refs In SPANISH *Its* Informe No. 127

Chlorella Vulgaris was cultivated in a medium containing assimilable phosphorus in the form of orthophosphate ($P^{32}O_4H_3$) to determine the amount of phosphorus incorporated by the lipid fraction under normal and heterotrophic (cultivated in the presence of glucose) conditions both with and without illumination. Phosphorus was more readily absorbed by some phospholipids than by others which is explained by preferential isotopic interchange. Light and darkness also affected phosphate transfer. Chlorella's development was especially slow in darkness and in the absence of glucose. R.N.A.

N65-21091 Joint Publications Research Service, Washington, D. C.

ON THE PERIODICITY OF LATENT PERIODS OF THE "INEXTINGUISHABLE" CONDITIONAL FUGITIVE REFLEX AND THE ATTEMPT OF A CYBERNETIC INTERPRETATION

C. Hecht and M. Peschel *In its* East German Publ. on Cybernetics 12 Mar. 1965 p 24–32 refs Transl. into ENGLISH from Acta Biol. Med. Ger. (East Berlin), v. 13, no. 4, 1964 p 504–512 (See N65-21089 10-34) CFSTI: $2.00

The application of mathematical frequency analysis to the results obtained for individual rats showed the existence of frequencies in all animals in given established procedure. Frequencies prevailed with periods ranging within 6, 7, 8 minutes and within 13, 14, 15 minutes; the manner of reaction of the individual animals permitted a classification into three groups. These groups were interpreted as adaptational types. Various possibilities of a cybernetic interpretation were discussed. The hypothesis of a linear regulating circuit with additional engagement by a governing organ seems most probable. E.E.B.

N65-21092# Joint Publications Research Service, Washington, D. C.

INTERACTION BETWEEN SUPRALIMINAL AND EXTERNAL INHIBITION

V. N. Andreyeva 6 Apr. 1965 11 p refs Transl. into ENGLISH from Zh. Vysshei Nervnoi Deyatel'nosti (Moscow), v. 14, no. 4, 1964 p 695–700

(JPRS-29460; TT-65-30666) CFSTI: $1.00

The possibility of disinhibition of supraliminal inhibition by external stimuli was investigated. Experiments were conducted on four dogs using the classical salivation–alimentary method to study the distinctive features of interaction between supraliminal and external inhibition. Disinhibition, as well as summation, was observed. The result of interaction between supraliminal and external inhibition depended mainly on the initial functional status, i.e., on the intensity of supraliminal inhibition. The physical intensity of extraneous signals was not the deciding factor determining the result of interaction between supraliminal and external inhibition. The ability to undergo disinhibition under the influence of extraneous stimuli is a sign common to both internal and supraliminal inhibition. E.E.B.

N65-20394 Library of Congress, Washington, D. C. Aerospace Technology Div.

PATTERN RECOGNITION AND THE METHOD OF POTENTIAL FUNCTIONS

In its Foreign Sci. Bull., Vol. 1, No. 1, Jan. 1965 (1965) p 19–22 refs (See N65-20390 10-34)

The problem of teaching automata to separate input situations into classes (the pattern-recognition problem) is analyzed, and the algorithm for its solution is presented on the basis of the method of potential functions. It is shown that the algorithm can be realized by means of a wide variety of computational schemes, and that the Rosenblatt perceptron is a particular case of the schemes described. The probabilistic approach to the solution of the pattern-recognition problem is also presented. Author

N65-20398# Lockheed Missiles and Space Co., Sunnyvale, Calif.

AN EXPERIMENTAL STUDY OF MANUAL CONTROL DURING TERMINAL RENDEZVOUS UNDER ADVERSE CONDITIONS

D. W. Eliason 1 Feb. 1965 33 p refs

(LMSC-6-65-65-1)

Human performance was measured in an orbital rendezvous task under adverse conditions, e.g., thrust misalinements. An experiment was carried out using four subjects, a control-display cockpit simulator, and a six degree of freedom analog computer mechanization. Two thrust configurations (single vs multiple engine) were studied and compared using performance criteria of fuel consumption and final errors in relative velocity and vehicle orientation. The single-axis attitude-thrust (single engine) configuration was superior with respect to fuel consumption. The three-axis orthogonal-thrust (multiple engine) configuration exhibited higher reliability and smaller final errors in relative velocity and orientation. Author

N65-20401*# Honeywell, Inc., Minneapolis, Minn.

STUDY OF AN ATTITUDE CONTROL SYSTEM FOR THE ASTRONAUT MANEUVERING UNIT Final Report, Dec. 1963–Jul. 1964

W. E. Drissel, R. L. Haines, R. J. Kell, D. N. Lovinger, and D. M. Moses Washington, NASA, Mar. 1965 288 p refs

(Contract NASw-841)

(NASA-CR-198) CFSTI: HC $6.00/MF $1.50

This report describes the work done under a study contract whose objectives were to study attitude control systems (ACS's) for astronaut maneuvering units (AMU's) and to define in detail the most nearly optimum system for the application. Detailed definition included identification or specification of principal components, and specification and drawing layout of all circuitry. The system uses a voice-operated controller for both attitude and translational control, three floated integrating gyros for attitude sensing, a fixed pulse and pseudorate control system, and eight reaction jets. Author

N65-20529# Denver Research Inst., Colo. Chemical Div. Lab.
INVESTIGATION AND DESIGN OF A REGENERABLE SILVER OXIDE SYSTEM FOR CARBON DIOXIDE CONTROL Final Report, 1 Apr. 1963–31 Mar. 1964
W. J. Culbertson, Jr. Wright-Patterson AFB, Ohio, AMRL, Dec. 1964 111 p refs *Its* Rept.-402
(Contract AF 33(657)-10928)
(AMRL-TR-64-119; AD-612021)

Precipitated carbonate was investigated using test tube samples to establish the merits of this approach to an Ag_2O solids system for CO_2 removal. Moisture catalyzes transport of CO_2 or Ag^+ through an Ag_2CO_3 layer protecting the Ag_2O from conversion to Ag_2CO_3. At the optimum 1% to 2 1/2% CO_2, over 24 hours are required for good yields, even at 100% humidity. Humidities of 50% result in even slower absorption. Regeneration to Ag_2O may be accomplished in moist partial vacuum at 125° C within 2 hours. The H_2O must reach the decomposing Ag_2CO_3 by penetrating a protective Ag_2O layer counterflow to the outflowing CO_2. Moisture is not necessary with Y^{+++} catalyst at 150° C. Absorption is speeded twofold to threefold with Y^{+++} catalyst. At 1/2% CO_2 and 50% humidity, 75% yield is attained within 16 hours. Preliminary work on several other metal oxides showed Zn and Pb to be most promising of these as a substitute for the short-lived Ag_2O. Author

N65-20565# Brown Engineering Co., Inc., Huntsville, Ala. Research Labs.
PHYSIO-MECHANICAL EFFECTS OF ACCELERATIONS ON HUMAN BEINGS WORKING ON A ROTATING ENVIRONMENT
Harry C. Crews, Jr. Nov. 1964 40 p refs
(R-63; AD-610132)

This report presents the results of an examination into the effects of a rotating environment on an enclosed human. The study was initiated due to concern that routine maintenance of radar equipment located in a large rotating room might be impossible, and began with a mechanical analysis of the accelerations on an object in a rotating enclosure. The results of the mechanical analysis agreed well with the experimental results. The primary object of this report is to provide a method of analysis that can lead to methods and procedures for reducing ill effects on humans. While the study was limited to rotation about one fixed axis, it can be extended to apply to a generally rotating environment. The review of applicable acceleration equations starts from the most general case. Author

N65-20613# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering
FORCE ANALYSIS OF WALKING AT REDUCED GRAVITY
Dennis Edward Beebe (M.S. Thesis) Aug. 1964 112 p refs
(MECH/GA-64-1; AD-610233)

In order to determine the primary surface reaction forces exerted by a man walking under reduced gravity, the vertical and longitudinal surface reaction forces were measured for a number of walking subjects, both on the ground and at reduced gravity levels between 0.1 and 1.0 g. Experiments included the study of normal walking, tempo variation, and pressure suit effects. Both reaction forces varied almost directly with gravity. The lower walking limit observed for the unsuited subjects was 0.12 g, where the limiting factor appeared to be the reduced magnitudes of the forces themselves rather than a change in their ratio. Author

N65-20726# Rocketdyne, Canoga Park, Calif.
SOURCES OF INFORMATION ON THE EFFECTS OF HUMAN PERFORMANCE ON PRODUCT AND SYSTEMS EFFECTIVENESS
George A. Peters and Frank S. Hall 15 Feb. 1965 186 p refs Revised
(RH-3398-J)

This is a comprehensive compilation of books, symposia, bibliographies, data, specifications, standards, handbooks, organizations, and other sources of information on ergonomics, system safety, bioastronautics, life sciences, aerospace medicine, reliability engineering, quality assurance, engineering psychology, personnel subsystem, and maintainability, with emphasis on human factors engineering. More than 1000 separate sources of information are listed or described. These are basic or primary references which provide access to the supporting literature, specify what should be done, describe how various functions might be accomplished, illustrate what was accomplished, or serve as design standards. Author

N65-20926# Library of Congress, Washington, D. C. Aerospace Technology Div.
DATA ON THE SOVIET SPACE PROGRAM, ANALYTICAL SURVEY
17 Mar. 1965 29 p refs
(ATD-P-65-11; AD-459646) CFSTI: HC $2.00/MF $0.50

Selected Soviet articles on guidance systems, human factors in interplanetary flight, pressure suits and spaceship cabins, trends in aerospace vehicle design, and extracts from papers on bioastronautics, simulated space flights, communications, and space vehicles are presented. E.E.B.

N65-20959# Intelectron Corp., New York.
ELECTRO-STIMULATION TECHNIQUES OF HEARING
Henry K. Puharich and Joseph L. Lawrence Griffiss AFB, N.Y., RADC, Dec. 1964 79 p refs
(Contract AF 30(602)-3051)
(ER-0038; RADC-TDR-64-18; AD-459956)

A transdermal hearing system was developed using modulated electrical carrier signals to stimulate sound perception. Current version of this system uses amplitude-modulated alternating-current carrier signals capacitively coupled to the skin of the head and neck. The transdermal system produces undistorted sound perception in normal humans and improvement in those with impaired hearing. It also elicits rudimentary signal discrimination in totally deaf humans. The transdermal stimulation of audition was extended to dogs made deaf by cochlear destruction as evidenced by positive conditioned reflex experiments. Author

N65-21048# Pittsburgh Univ., Pa.
REPETITION AND SPACED REVIEW IN PROGRAMED INSTRUCTION Final Report, Oct. 1961–Oct. 1962
James H. Reynolds, Robert Glaser, John S. Abma, and Ross L. Morgan (AMRL) Wright-Patterson AFB, Ohio, AMRL, Dec. 1964 35 p refs
(Contracts AF 33(616)-7175; OE-2-10-057)
(AMRL-TR-64-128; AD-612738)

Experiments one and two covered a one-semester course in general science at junior high school level. In experiment three, a 1280-frame portion of the total course was used. The results of experiments one and two indicate that the programed course was at least as effective as the conventional instruction in terms of both learning and retention after 15 weeks. The

linear program was superior to conventional instruction on some measures. The spiral program offered few advantages over the regular linear program. In experiment three, spaced review produced significant increases in learning which persisted, and even increased, through a 3-week retention interval; repetition did not produce increased learning or retention. The general conclusions are (1) repetition of instructional materials above the usual level in a linear program is not beneficial; (2) spaced review is potentially beneficial; and (3) some techniques of obtaining spaced review offer disadvantages that equal or outweigh its potential advantages. Author

N65-21144# Electronic Systems Div., Bedford, Mass. Decision Sciences Lab.
INVESTIGATIONS OF ACOUSTIC EFFECTS UPON VISUAL SIGNAL DETECTION
William H. Watkins and Carl E. Feehrer Dec. 1964 28 p refs
(ESD-TR-64-557; AD-612768)

Several patterns of aural white noise of moderate intensity were presented in four forced-choice experiments to investigate acoustic influence upon visual detection. When noise was present, but not continuous, the temporal properties of its bursts or interruptions bore a regular relation to the observation intervals involved in the visual task. Detection rates were highest when bursts of noise coincided with observation intervals. Rates were somewhat higher when there were interruptions at observation intervals than when noise was continuous. Acoustic facilitation was reduced to a (statistically) nonsignificant level when the visual signal was made spatially coincident with one of four light flashes. Practice effects were present over the full span of the longest of these experiments, but were not obvious in each of the experiments. Author

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N65-20199# Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf (Austria). Reaktorzentrum Seibersdorf
DETERMINATION OF BORON IN STEEL BY INVERSE NEUTRON ACTIVATION ANALYSIS
H. Spenke, T. Cless-Bernert, and B. Karlik 1964 8 p ref
(SGAE-IB/IA-5/1964)

A simple nondestructive method developed for determination of boron in steel by making use of the neutron depression due to B^{10} is described. A gold foil of 0.05-mm thickness and 11.3-mm diameter is inserted between two discs of boron steel of 2-mm thickness and 20-mm diameter and also between two discs of identical size of the boron-free standard steel. Using a calibration curve and comparing the activities of Fe^{59} or other nuclei inside the boron steel sample and the boron-free steel sample, an accuracy better than 1% for the relative values can be obtained. R.W.H.

N65-20242# Esso Research and Engineering Co., Baytown, Tex.
REACTIONS OF GASEOUS IONS. XIV: MASS SPECTROMETRIC STUDIES OF METHANE AT PRESSURES TO 2 TORR
F. H. Field and M. S. B. Munson Feb. 1965 27 p refs Submitted for Publication
(Contract Nonr-3623(00); Proj. Squid)
(HUM-10-P; AD-458846)

Gaseous ionic reactions were observed in the source of a mass spectrometer at pressures as high as 2 torr. The general pattern of reactions is the same as that observed previously at pressures up to 0.3 torr. The CH_5^+, $C_2H_4^+$, $C_2H_5^+$, and $C_3H_5^+$ do not react appreciably with methane even though exothermic reactions can be written for the latter three ions. The rate constant for reaction of $C_2H_3^+$ with CH_4 is five times the rate constant for reaction of $C_2H_3^+$ with CH_4. These observations of chemical effects on reaction rates are not explained by present theory. These data support the suggestions that the high molecular weight polymers formed in high energy irradiation of methane by ionic processes come from reactions of the hydrogen deficient ions of low concentration, C^+ and CH^+. Author

N65-20246# California Univ., Berkeley. Dept. of Chemistry
SPECTROSCOPIC AND THEORETICAL STUDIES OF MOLECULES WITH BONDING WHICH DEVIATES FROM NORMAL VALENCE RULES Final Report, 1 Mar. 1961–28 Feb. 1965
George C. Pimentel 15 Dec. 1964 12 p refs
(Contract AF 49(638)-944; Grant AF-AFOSR-332-63)
(AFOSR-65-0068; AD-610160)

Structural properties and chemical bonding of molecules that deviate from normal valence rules were investigated. Effort was devoted to three areas: spectroscopic studies of the reactivity and molecular structure of free radicals and reactive molecules using the matrix isolation method; spectroscopic studies of stable molecules selected to develop and expand the applicability of the matrix isolation method; and development of new and novel spectroscopic techniques to facilitate future infrared studies of chemical species with extreme reactivity. R.W.H.

N65-20289# Defence Research Board, Ottawa (Ontario).
DETERMINATION OF THE DIFFUSION SPEED OF HYDROGEN IN GOLD
Walter Eichenauer and Dagmar Liebscher Feb. 1963 3 p refs Transl. into ENGLISH from Z. Naturforsch. (Tübingen), 17 a, 355, 1962
(T-109-6)

The hydrogen emission of gold balls was measured as a function of time for the purpose of determining the diffusion coefficients of hydrogen in gold. The results show that a gram atom of gold at 700° C absorbs about 4×10^{-6}, and at 900° C about 8×10^{6} mols of hydrogen at a loading pressure of one atmosphere. E.W.

N65-20376# Westinghouse Electric Corp., Pittsburgh, Pa. Westinghouse Research Labs.
TRANSPORT STUDIES OF DEFECT STRUCTURE INORGANIC COMPOUNDS Semiannual Technical Report, 1 Apr.–30 Sep. 1964
[1964] 64 p refs
(Contract Nonr-3800(00); ARPA Order 300)
(AD-610087)

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2. CONDUCTIVITY PROCESSES AT HIGH DOPING LEVELS R. R. Heikes 7 p refs (See N65-20378 10-25)

3. DEFECT STRUCTURE AND ELECTRICAL CONDUCTIVITY OF ThO_2-Y_2O_3 SOLID SOLUTIONS E. C. Subbarao, P. H. Sutter, and J. Hrizo 21 p refs (See N65-20379 10-06)

4. HIGH TEMPERATURE INDUCTION FURNACE WITH OXIDE SUSCEPTORS P. H. Sutter, E. C. Subbarao, and J. Hrizo 11 p refs (See N65-20380 10-06)

N65-20377 Westinghouse Electric Corp., Pittsburgh, Pa. Westinghouse Research Labs.

THE EFFECT OF ELECTRODE PRETREATMENT ON THE OXYGEN REDUCTION ON PLATINUM IN PERCHLORIC ACID

Y. L. Sandler and E. A. Pantier *In its* Transport Studies of Defect Struct. Inorg. Compds. [1964] 22 p refs (See N65-20376 10-06)

The effect of pretreatment of a platinum electrode on the electrochemical reduction of oxygen and of hydrogen peroxide in perchloric acid was studied at room temperature. Hydrogen and oxygen pretreatments affect the oxygen reduction in a manner similar to cathodic and anodic pretreatments, respectively. Removal of strongly bound oxygen by hydrogen pretreatment or cathodization accelerates the decomposition of hydrogen peroxide and increases the open circuit potential and the rate of the oxygen reduction in solutions containing 10^{-5} to 10^{-7} M peroxide. Decay rates from a high anodic potential provide a sensitive measure for peroxide concentrations in the electrolyte. Author

N65-20379 Westinghouse Electric Corp., Pittsburgh, Pa. Westinghouse Research Labs.

DEFECT STRUCTURE AND ELECTRICAL CONDUCTIVITY OF ThO_2-Y_2O_3 SOLID SOLUTIONS

E. C. Subbarao, P. H. Sutter, and J. Hrizo *In its* Transport Studies of Defect Struct. Inorg. Compds. [1964] 21 p refs (See N65-20376 10-06)

Compositions in the ThO_2-$YO_{1.5}$ system were coprecipitated as the oxalates and converted to the oxides. Disks were pressed and sintered in oxygen at 1400° to 2200° C. Densities of the sintered disks were 96% to 98% of the theoretical. Solid solutions with the fluorite-type structure are formed up to 20 to 25 mole % $YO_{1.5}$ at 1400° C and up to 45 to 50 mole % $YO_{1.5}$ at 2200° C. Density data showed that these solid solutions correspond to $Th_{1-x}Y_xO_{2-0.5x}$, having a complete cation sublattice filled by Th^{4+} and Y^{3+} ions, and vacancies in the anion sublattice. The observed increase in electrical conductivity with increase in $YO_{1.5}$ content is consistent with charge transport by oxygen ions through a vacancy mechanism. Approximately 7 mole % ThO_2 is soluble in $YO_{1.5}$ at 2200° C. Density results indicate an anion interstitial structure for the Y_2O_3 phase. Transference number measurements indicate that the electrical conductivities are only partially due to ions. Author

N65-20380 Westinghouse Electric Corp., Pittsburgh, Pa. Westinghouse Research Labs.

HIGH TEMPERATURE INDUCTION FURNACE WITH OXIDE SUSCEPTORS

P. H. Sutter, E. C. Subbarao, and J. Hrizo *In its* Transport Studies of Defect Struct. Inorg. Compds. [1964] 11 p refs (See N65-20376 10-06)

Radio-frequency induction furnaces with refractory oxide susceptors operate at temperatures well above 2000° C in an air or oxygen atmosphere. The CaO-ZrO_2 susceptor furnace is easy to construct and is inexpensive if a relatively small 10-kilowatt, 4-megacycle rf generator is available. Author

N65-20396 Library of Congress Washington, D. C. Aerospace Technology Div.

GROWING PIEZOELECTRIC POTASSIUM NIOBATE

In its Foreign Sci. Bull., Vol. 1, No. 1, Jan. 1965 [1965] p 30–32 refs (See N65-20390 10-34)

Recent Soviet advances in preparing potassium niobate single crystals for use in certain piezoelectric devices are reviewed. The development of the method of oriented crystallization from molten solutions in potash with seeding is described. Progress is noted in securing large (up to 6 cc), uniformly colored single crystals having characteristic ferroelectric properties. Author

N65-20399# Olin Mathieson Chemical Corp., New Haven, Conn. Chemicals Div.

DEVELOPMENT OF A FIRE-RESISTANT WATER-BASE HYDRAULIC FLUID Bimonthly Progress Report, 1 Nov.–31 Dec. 1964

E. H. Kober and G. F. Ottmann 11 Jan. 1965 24 p
(Contract NObs-90268)
(BMPR-4; AD-609952)

Alkoxylation studies of 2, 4-toluylene diamine, hydroxy diphenyl oxide, oxydianiline, 4, 4'-methylene bis 2-chloroaniline, bis phenol A, and N, N'-diphenyl p-phenylene diamine with ethylene oxide and glycidol in different mole ratios were completed. As a result, compositions of those alkoxylation products which provide for the lowest possible viscosities of their aqueous solutions at 25° F without detrimentally affecting other properties were established. Studies on the formulation of six selected fluid base stocks were initiated. A fluid composed of alkoxylated hydroxy diphenyl oxide as base stock, Ucon 90000 as viscosity index improver, and water, met the specifications for viscosity, pour point, autogenous ignition temperature, flash and fire points. Author

N65-20419*# Brigham Young Univ., Provo, Utah. Chemistry Dept.

STUDIES OF REACTION GEOMETRY IN OXIDATION AND REDUCTION OF THE ALKALINE SILVER ELECTRODE

Eliot A. Butler Feb. 1965 18 p refs Prepared for JPL
(Contracts NAS7-100; JPL-AE4-310901)
(NASA-CR-57644) CFSTI: HC $1.00/MF $0.50

In reduction of the alkaline AgO electrode the reaction occurs preferentially in regions where the oxide layer is thinnest. Surface roughness and shallow pitting do not cause perceptible effect upon the reaction. A depth discontinuity in the AgO, however, results in preferential reactions beneath the thin region. The reaction on discharge of AgO plates started at a current density of 0.23 to 6.4 mA/cm^2. In oxidation of sintered silver plates at 3 mA/cm^2 the reaction started always at the solution-sintered interface and proceeded toward the grid. In constant potential oxidation of sintered silver plates a current minimum is consistently observed soon after the start of oxidation. Investigation of this is being continued. Author

N65-20427# California Inst. of Tech., Pasadena. Div. of Chemistry and Chemical Engineering

NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY. THE CONFIGURATIONAL STABILITY OF PRIMARY GRIGNARD REAGENTS. STRUCTURE AND MEDIUM EFFECTS

George M. Whitesides and John D. Roberts Dec. 1964 56 p refs Submitted for Publication
(Contract Nonr-220(26))
(TR-38; AD-455118)

Qualitative and semiquantitative examination of the temperature dependence of the RCH_2–Mg proton nuclear magnetic resonance spectra of several Grignard reagents indicates that the rate of inversion at this center is relatively insensitive to the structure of the group R. Secondary Grignard reagents invert much more slowly, if at all. The dependence of the inversion rate of the primary organometallic compounds on solvent character and on added salts suggests that inversion proceeds by means of a mechanism having kinetic order greater than one. Author

N65-20440# Harvard Univ., Cambridge, Mass. Mallinckrodt Chemical Labs.
MICROWAVE DOUBLE RESONANCE EXPERIMENTS
A. P. Cox, G. W. Flynn, and E. B. Wilson, Jr. [1963] 45 p refs
(Contract Nonr-1866(14))
(AD-610261)

Double quantum transitions and certain changes in line intensities which can be ascribed to relaxation effects were observed in a Stark effect spectrometer in which the absorbing gas was exposed to two microwave fields simultaneously. The general features of the line shape predicted by Javan for a three-level system in the presence of two irradiating fields have been clearly observed in OCS and propylene oxide. Studies of various transitions in these molecules indicate the presence of either a double quantum emission or absorption line depending upon the energy level scheme in question. Observation of both zero-field and Stark transitions revealed certain expected changes in line intensities. Several experimental arrangements for microwave double resonance are described and applications of this technique to the identification and confirmation of complex rotational spectra are discussed. Author

N65-20446# Union Carbide Plastics Co., Bound Brook, N. J. Research and Development Dept.
RESEARCH ON IMPROVED EPOXY RESINS Quarterly Progress Report, Oct. 1, 1964–Jan. 1, 1965
J. R. Harvey, W. P. Mulvaney, R. F. Sellers, S. G. Smith, Jr., and A. C. Soldatos 1 Jan. 1965 45 p
(Contract Nonr-4172(00)(X))
(QPR-7; AD-610036)

The purpose of this program is to define the correlation of novel polyepoxide molecular configurations with the physical properties of cured resins as the initial step in providing significant improvements in filament-reinforced plastics for deep submergence structures. The synthesis and evaluation of new epoxy resin configurations continued. Increased emphasis was placed on greater realization of the potential performance of the more promising epoxy resins through such variables as formulation, handling technique, resin quality, and curing schedules. Significant improvement in the interlaminar shear strength of ERRA-0300, was achieved through formulation. Preliminary data for shear strength after water boil and for flexural stress rupture properties in salt water are reported for ERLA-0400, ERRA-0300, and ERNA-0386 to indicate the type of performance to be expected under service conditions. Physical property data accumulated under the program were compared to the molecular spacing within each epoxy resin configuration. Definitive curves for these correlations are presented. Author

N65-20481*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
RATES OF HYDROGEN-GRAPHITE REACTION BETWEEN 1550° AND 2260°C
William A. Sanders Washington, NASA, Apr. 1965 11 p refs
(NASA-TN-D-2738) CFSTI: HC $1.00/MF $0.50

The rates of reaction of a pitch-free, petroleum coke-base graphite with purified hydrogen were determined in the temperature range 1550° to 2660° C. Experimental weight losses agree very well above 1800° C with calculations based on thermodynamic data for the hydrogen–graphite theoretical equilibrium compositions, where acetylene is calculated to be the major reaction product. Although the experimental curve and the theoretical curve diverge below 1800° C, equilibrium might be achieved at temperatures below 1800° C if slower hydrogen flow rates were employed. Author

N65-20484*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ANALYSIS OF OXYGEN IN POTASSIUM
Washington, NASA, Mar. 1965 33 p ref NASA Round-Robin Meeting held at Lewis Res. Center, Cleveland, 4 Jun. 1964
(NASA-TM-X-1085) CFSTI: HC $2.00/MF $0.50

Analyses of low and high series of potassium samples for their oxygen content by Hg amalgamation or vacuum distillation are discussed, and descriptions of the various analytical procedures are presented. It was found: (1) There is general agreement between the hot amalgamation results of approximately 100-ppm oxygen. (2) Results of vacuum distillation and cold mercury amalgamation agree well with an alkalinity equivalent to about 1100-ppm oxygen in the potassium samples. Techniques to determine the oxygen content in potassium with the help of alkyl halide or ammonia were judged unsatisfactory. G.G.

N65-20519# Army Electronics Labs., Fort Monmouth, N. J. Electronic Parts and Materials Div.
CHEMICAL DEPOSITION AND THE FORMATION OF MIXED FERRITE FILMS
William L. Wade, Jr., Thomas Collins, and William J. Skudera, Jr. Dec. 1964 14 p refs
(ECOM-2542; AD-611774)

This report details the chemical preparation processes for formation of three cation spinel ferrite films and garnet ferrite films. Analysis and calculation of the basic chemical solutions are included. Crystal structure and composition are verified by X-ray diffraction analysis. Magnetic properties are evaluated at X-band by cavity-resonance measurements. Experimental data are included. Alcoholic solutions of ferric nitrate and other metal nitrates were combined in necessary proportions to yield stoichiometric ratios of the desired ferrites, which were then deposited on substrates. Firing the coated substrates between 900° and 10° C in a controlled atmosphere resulted in spinel and garnet ferrite formation. Author

N65-20530 Israel Program for Scientific Translations, LTD., Jerusalem.
PROCEEDINGS OF THE SECOND ALL-UNION CONFERENCE ON RADIATION CHEMISTRY
1964 814 p refs Transl. into ENGLISH of the book "Trudy II Vsesoyuznogo Soveshchaniya po Radiatsionnoi Khimii" Moscow, Izd. Akad. Nauk SSSR, 1962 Published for AEC and NSF
(IPST-1036; AEC-TR-6228)

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RADIATION EFFECTS IN SOLIDS p 686-753 refs

EXPERIMENTAL METHODS IN RADIATION CHEMISTRY p 759-800 refs

N65-20555# Gulton Industries, Inc., Metuchen, N. J.
LITHIUM-NICKEL HALIDE SECONDARY BATTERY INVESTIGATION Final Technical Report, Dec. 1963-Dec. 1964
A. Lyall, H. N. Seiger, and R. C. Shair Jan. 1965 58 p
(Contract AF 33(615)-1266)
(AFAPL-TR-11; AD-612492)

This report encompasses a study of the electrode processes, the electrolyte, and cell components of the nickel chloride-lithium cell. Some experimental work was done on the nickel fluoride electrode. A major modification to the propylene carbonate-$AlCl_3$ electrolyte was made—the electrolyte was chlorinated and the excess chlorine scavenged with lithium metal, which greatly reduced the kinetic polarization originally associated with the nickel chloride electrode. A satisfactory lithium electrode was prepared by pasting an oil mixture of powdered lithium, carbonyl nickel and a carboxymethylcellulose binder on an expanded nickel screen. Three good separator materials were found for the chloride system. Through the technique of formation cycling, nickel chloride electrodes were prepared which yield 80% utilization of the theoretical capacity. Concentration polarization at the nickel chloride electrode restricts the discharge rate to C/40 and charge rates C/20. Methods of reducing the concentration polarization are outlined. Author

N65-20576# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 156
9 Mar. 1965 107 p refs Transl. into ENGLISH from Chinese periodicals
(JPRS-29037; TT-65-30464) CFSTI: $4.00

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2. PRODUCTION OF ALUMINA CEMENT BY SINTER PROCESS IN CONVERTER W. Tso, Y. Wang, H. Hu, and C. T'ien p 4-24 refs (See N65-20577 10-18)
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5. SYNTHESIS AND CERTAIN REACTIONS OF P-TOLYLFERROCENE S. Shih, H. Sung, and F. Li p 33-35 refs (See N65-20578 10-06)
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8. PUBLICATION OF ABSTRACTS OF PAPERS PRESENTED AT THE 1964 ANNUAL MEETING OF THE CHEMICAL AND CHEMICAL ENGINEERING SOCIETY OF SHANGHAI p 69-70
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N65-20578 Joint Publications Research Service, Washington, D. C.
SYNTHESIS AND CERTAIN REACTIONS OF P-TOLYLFERROCENE
Shu-chien Shih, Hsueh-tzu Sung, and Feng-tse Li *In its* Transl. on Communist China's Sci. and Technol., No. 156 9 Mar. 1965 p 33-35 refs Transl. into ENGLISH from K'o Hsueh T'ung Pao (Peiping), no. 1, 17 Jan. 1965 p 78-79 (See N65-20576 10-06) CFSTI: $4.00

Bloody-red rhombohedral crystals of paratolylferrocene were synthesized by arylation of the diazonium salt of para-amino benzaldehyde with ferrocene. A binary substituted compound of diparatolylferrocene, in bloody-red needles, was also obtained. Reactions in various solvents were studied, and constants of melting and decomposition temperatures determined. E.P.V.

N65-20579 Joint Publications Research Service, Washington, D. C.
THERMAL STABILITY OF HIGH POLYMERS
Shan-Nung Chu *In its* Transl. on Communist China's Sci. and Technol., No. 156 9 Mar. 1965 p 36-57 refs Transl. into ENGLISH from Hua Hsueh Tung Pao (Peiping), no. 12, Dec. 1964 p 12-20 (See N65-20576 10-06) CFSTI: $4.00

The thermal decomposition structure and characteristic of high polymers are principally determined by their chemical structures. But the thermal decomposition speed and thermal stability of the high polymers are intimately connected to its chain structure. The included examples show that to decrease the weaknesses on high polymers and to lower the thermal instability, copolymerization techniques could be used by adding a second small quantity of monomers. This would decrease the interaction of neighboring groups on a high polymer chain and its influence on thermal decomposition. It is also important to study the thermal stability of high polymers and how their chain structure affects thermal stability. Author

N65-20580 Joint Publications Research Service, Washington, D. C.
COLORIMETRIC DETERMINATION OF TOTAL MINUTE AMOUNT OF RARE EARTH ELEMENTS AND THORIUM IN ORE
Kuo-T'ai Yu *In its* Transl. on Communist China's Sci. and Technol., No. 156 9 Mar. 1965 p 58–68 refs Transl. into ENGLISH from Hua Hsueh Shih Chieh no. 12, Dec. 1964 p 565–568 (See N65-20576 10-06) CFSTI: $4.00

Experimental results demonstrate high sensitivity for the colorimetric method described. It is suitable for determining total amounts of rare-earth elements and thorium in the range of 0.001% to 1.0%. Rapid determination of total amounts by uranium reagent differences shown in photoelectric colorimetry satisfies mass production requirements for laboratory and industrial scales. This method allows the presence of interfering elements, such as 50-gamma of niobium, tantalum, zirconium, or titanium, and 5 milligrams of calcium, which do not affect the colorimetry. E.P.V.

N65-20581 Joint Publications Research Service, Washington, D. C.
THE APPLICATION OF HYDRAZINE IN ORGANIC SYNTHESIS
T'ung-Sheng Chung *In its* Transl. on Communist China's Sci. and Technol., No. 156 9 Mar. 1965 p 71–93 refs Transl. into ENGLISH from Hua Hsueh Tung Pao (Peiping), no. 11, Nov. 1964 p 34–43 (See N65-20576 10-06) CFSTI: $4.00

Various applications of hydrazine in organic synthesis are surveyed, and a bibliography is presented. Preparation of amines by reduction of aromatic nitro-compounds is discussed. Methods for preparation of aldehyde from carboxylic acid and from nitrile compounds are considered, as well as carbonyl reduction reactions. Transformations of epoxy ketones into compounds of the allyl alcohol type are presented. A reaction is shown for reduction of an epoxide to a hydroxy compound, and methods are given for hydrogenation of double and triple carbon–carbon bonds. E.P.V.

N65-20583 Joint Publications Research Service, Washington, D. C.
NEW TYPES OF POLYMERIZATION REACTIONS
Hsi-tseng Yao *In its* Transl. on Communist China's Sci. and Technol., No. 162 23 Mar. 1965 p 1–17 refs Transl. into ENGLISH from Hua-hsueh Hsueh-Pao (Peking), no. 1, Jan. 1965 p 21–27 (See N65-20582 10-34) CFSTI: $2.00

Processes for the preparation of high polymers directly from the organic compounds found in petroleum crude are discussed. These methods were divided into the following: cracking, oxidation–catalysis, combination, azo-salt decomposition, Diels–Alder reaction, Ullman reaction, Knoevenagel reaction, denitration of azo-paraffins, Witting reaction, and the Wurtz–Fitting reaction. Also, the preparation of polymers from monomers containing containing sulfur and oxygen in the carbon chain are included. E.E.B.

N65-20593# Army Materials Research Agency, Watertown, Mass. Metals and Ceramics Research Labs.
EMISSION SPECTROGRAPHIC SOLUTION TECHNIQUES WITH APPLICATIONS TO THE ANALYSIS OF URANIUM AND TITANIUM ALLOYS
W. K. Murray Jun. 1963 12 p Presented at the Pittsburgh Conf. on Anal. Chem. and Appl. Spectry., Mar. 1963
(AMRA-MS-63-01; AD-609901)

To determine whether reference solutions are required for every variation in the alloys submitted for solution spectrography, a number of titanium alloy solutions were prepared. There was no effect on the determination of tin, zirconium, or columbium regardless of the presence or absence of aluminum or vanadium. Next, the matrix element was changed to iron, and the relative intensities observed for nickel and chromium were unchanged. Other tests showed that, although changes in the acid concentration of the solutions caused changes in the observed relative intensities for some elements, if the acid concentrations are kept reasonably constant, the effect on the relative intensities is of only minor significance. Next to acid concentration, the greatest source of error was found to be variations in the excitation conditions. To correct for the excitation variations, either an excitation index can be used to measure the reproducibility, or the excitation index can be used to apply a correction to the observed data. Techniques used for solution spectrography of titanium alloys are described briefly. M.P.G.

N65-20596# Battelle Memorial Inst., Columbus, Ohio.
DEVELOPMENT OF ANALYTICAL TECHNIQUES FOR THE DETERMINATION OF MINUTE QUANTITIES OF SELECTED ELEMENTS IN BERYLLIUM Interim Report, 20 Sep.–20 Nov. 1964
W. M. Henry 31 Dec. 1964 32 p ref
(Contract NOw-64-0081-c)
(IR-5; AD-454870)

The work discussed was principally in the areas of preparation of ^{17}O-doped beryllium metal for use in standardization of the mass-spectrographic method of determining oxygen, and in extension of the sensitivity of combustion methods for determining low amounts of carbon. In the work on carbon, considerable effort was spent on using a gas mass spectrometer as the carbon readout method. Author

N65-20647# Royal Aircraft Establishment, Farnborough (England).
SILICON CARBIDE—A REVIEW
A. R. G. Brown London, Min. of Aviation, Aug. 1960 37 p refs
(RAE-TN-MET/PHYS-325)

Published information on the production of pure silicon carbide and the fabrication of dense bodies of pure self-bonded SiC is reviewed. The structure and growth mechanism of SiC are briefly considered, and the major chemical, physical, and mechanical properties are abstracted. Author

N65-20663# Royal Aircraft Establishment, Farnborough (England).
PERFLUOROPOLYPHENYLENES FROM PENTAFLUOROPHENYLMAGNESIUM BROMIDE
E. J. P. Fear, J. Thrower, and M. A. White London, Min. of Aviation, Aug. 1963 16 p refs Presented at the 19th Intern. Congr. of Pure and Appl. Chem., London, Jul. 1963
(RAE-TN-CPM-26)

Decomposition of pentafluorophenylmagnesium bromide in tetrahydrofuran gives fluoropolyphenylenes of relatively high molecular weight; however, their structure is uncertain and they always contain bromine. Decomposition in the presence of perfluorobiphenyl provides an attractive route to perfluoropolyphenylenes of lower molecular weight. These probably have a para-linked structure. Author

N65-20664# Royal Aircraft Establishment, Farnborough (England).
ELECTRON IMPACT STUDIES OF FLUOROCARBONS. PART I: (PERFLUOROBIPHENYL)

J. L. Cotter London, Min. of Aviation, Oct. 1963 16 p refs (RAE-TN-CPM-39)

The mass spectrum of perfluorobiphenyl was recorded, and the appearance potentials of selected ions were determined. The results show perfluorobiphenyl to be relatively stable to ionizing radiation, and in the absence of excess energies the carbon–fluorine bond dissociation energy in perfluorobiphenyl is estimated to be about the same as that in hexafluorobenzene. Because of the high excess energies involved in the formation of the pentafluorophenyl ion from perfluorobiphenyl, it is not possible to estimate the dissociation energy of the central carbon–carbon bond in this molecule. Author

N65-20690# India. Dept. of Atomic Energy, Bombay. Chemistry Div.

DIFFUSION OF COPPER IN NICKEL

S. P. Murarka, M. S. Anand, and R. P. Agarwala 1964 10 p refs

(AEET/CD/31)

Diffusion of copper in nickel was studied, using radioactive tracer and residual activity method, in the temperature range of 800° to 1050° C. The diffusion coefficient (in cm^2/sec) is given by

$$D_{Cu/Ni} = 0.724 \exp(-61\,000/RT)$$

A vacancy mechanism of diffusion was suggested. A good agreement has been observed with different theoretical calculations for the impurity diffusion in metal. Author

N65-20691# Argonne National Lab., Ill. Chemical Engineering Div.

ENGINEERING DEVELOPMENT OF FLUID-BED FLUORIDE VOLATILITY PROCESSES. PART I: BENCH-SCALE INVESTIGATION OF A PROCESS FOR ZIRCONIUM-URANIUM ALLOY FUEL

D. Ramaswami, N. M. Levitz, J. T. Holmes, and A. A. Jonke Dec. 1964 62 p refs

(Contract W-31-109-ENG-38)

(ANL-6829) CFSTI: $3.00

A fluid-bed fluoride volatility process for the recovery of uranium from highly enriched uranium–zircaloy-2 and uranium–aluminum alloy fuels was developed. The conceptual process involves two basic chemical reaction steps conducted in a fluid-bed reactor. In the first step, the alloying material is separated as a volatile chloride by reaction with hydrogen chloride. In the second step, the uranium is recovered as its volatile hexafluoride by reaction with fluorine. Process development work conducted in a 1 1/2-in.-diam. nickel fluid-bed reactor with normal uranium–Zircaloy-2 alloys showed that recovery of greater than 99% of the uranium in the fuel can be achieved. High decontamination from fission products is expected on the basis of technology developed in previous studies. Considerable economic advantage of this process over current reprocessing schemes appears possible because (a) small waste volumes are produced, mostly in solid form; (b) considerable flexibility in process operating conditions exists; (c) overall fewer operations are needed; and (d) the product is uranium hexafluoride, which is readily amenable for isotope separation or conversion for reuse as fuel. Author

N65-20696# Aerojet-General Nucleonics, San Ramon, Calif.

THE FRACTION OF EFFUSING MOLECULES STRIKING A COLLECTOR PLATE OVER A CIRCULAR CAPILLARY

A. R. Miller Dec. 1964 60 p refs

(Contract DA-44-009-AMC-829(X))

(AN-1328; AD-454732)

Angular distribution probabilities for molecular effusion through circular capillaries were calculated for 46 values of length-to-radius and every integral value of the distributional angle. Author

N65-20698# France. Ministère de l'Air, Paris.

ON THE OXIDATION BY TETRAACETATE OF LEAD ON MALONIC DIESTERS AND SOME RELATED COMPOUNDS [SUR L'OXYDATION PAR LE TETRACETATE DE PLOMB DES HEMIESTERS MALONIQUES ET DE QUELQUES COMPOSES APPARENTES]

Massoud Rouhi-Laridjan: 1964 53 p refs In FRENCH

(NT-141)

A new method is described for the preparation of α-acetoxy-esters by oxidation, using lead tetraacetate, of substituted malonic diesters. A study of the mechanism of this reaction by kinetic and cryometric methods is presented. The discovery of an addition compound between the diester and trivalent lead is reported. The diesters are obtained by direct alkylation of ethyl malonate acid. Trans. by M.P.G.

N65-20709# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.

DETERMINATION OF ^{95}Zr AND ^{95}Nb IN MIXTURES OF THE TWO NUCLIDES

E. Kenneth Dukes, M. Yates Donnan, and Richard M. Wallace Feb. 1965 17 p refs

(Contract AT(07-2)-1)

(DP-933) CFSTI: $1.00

A method based on decay measurements was developed to determine the relative amounts of zirconium-95 and niobium-95 in mixtures of the two nuclides. The method was tested on synthetic and process solutions; plutonium and ruthenium did not interfere. Author

N65-20713# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

STUDY OF THE POSSIBILITY OF OBTAINING GAS TURBINE FUEL FROM THE PRODUCTS OF CATALYTIC CRACKING AND COKING

O. I. Svetozarova, V. V. Zhdanova, and E. P. Levashova 23 Dec. 1964 11 p refs Transl. into ENGLISH from Tekhnol. Pererabotki Nefti i Gaza, Tr. Groznensk. Neft. Nauchno-Issled. Inst. (Moscow), no. 12, 1963 p 61–68

(FTD-TT-64-594/1; AD-610290)

The physical and chemical properties of distillates, obtained in the catalytic cracking of gas oils and the products from contact coking of heavy petroleum residues, are reported. The distillates obtained in the catalytic cracking of light raw materials were shown to be useful as low-ash, low-congealing components of gas turbine fuel. The yield of distillate fuels amounted to 43% to 52.5% of the cracked raw material. For production of light, low-ash gas turbine fuels with traces of vanadium, the process of coking heavy petroleum residues should be accomplished by recirculation. In contact coking of raw material with recirculation of the sulfurous pitch, tar, and cracking residue, the yield of low-ash gas turbine fuel amounted to 45%, 56.2%, and 64.4%, respectively. E.E.B.

N65-20729# Army Engineer Research and Development Labs., Fort Belvoir, Va.

PROCEEDINGS OF THE TWELFTH BASIC RESEARCH GROUP CONTRACTORS' CONFERENCE AND SYMPOSIUM

M. D. Kemp [1963] 274 p refs Conf. held at Army Eng. Res. and Develop. Labs., Fort Belvoir, Va., 6-8 Nov. 1963 (AD-613076)

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4. THE PREPARATION AND PROPERTIES OF SOME NOVEL LIGHT METAL AZIDES K. Terada, A. J. Erbel, and F. M. Brower (Dow Chem. Co.) p 21-38 refs

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18. PARAMAGNETIC RESONANCE OF Mn^{++} IN SODIUM AZIDE G. J. King and B. S. Miller p 145-150 refs

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26. INFRARED STUDIES OF ORGANIC AZIDES Eugene Lieber and C. N. R. Rao (Roosevelt Univ.) p 225-234 refs

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28. INFRARED SPECTROSCOPIC EVIDENCE FOR THE SPECIES NH Dolphus E. Milligan and Marilyn E. Jacox (Natl. Bur. of Std.) p 247-250 refs

29. GROUP THEORETICAL ANALYSIS OF THE VIBRATIONAL SPECTRUM OF IMPURITIES IN CRYSTALS L. A. Veguilla-Berdecia and George C. Turrell (Howard Univ.) p 251-256 refs

30. MOLECULAR SPECTROSCOPY IN THE BASIC RESEARCH LABORATORY James I. Bryant p 257-271 refs

N65-20732# Royal Aircraft Establishment, Farnborough (England).

THE SUB-MICRO DETERMINATION OF BROMINE IN ORGANIC MATERIALS

T. R. F. W. Fennell and J. R. Webb London, Min. of Aviation, Jul. 1964 8 p refs

(RAE-TN-CPM-77)

A submicro method for the determination of bromine in solid organic compounds was developed. Sample weights, in the range 40 to 80 μg for all but one of the materials analyzed, were taken such that the bromine content lay in the range 10 to 40 μg. Results obtained from the analysis of standard compounds were all within $\pm 0.4\%$ absolute. Ten determinations of bromine in bromobenzoic acid gave a mean of 39.71% Br (calculated 39.75%), standard deviation 0.176. Satisfactory results were obtained for the analysis of research compounds containing fluorine, nitrogen, or phosphorus. Author

N65-20736# Royal Aircraft Establishment, Farnborough (England).

FLUOROAROMATIC POLYMERS, A REVIEW

V. C. R. Mc Loughlin and J. Thrower London, Min. of Aviation, Mar. 1964 19 p refs

(RAE-CPM-11)

The development of fluoroaromatic chemistry is discussed, especially with regard to present day requirements for heat-stable materials. The routes to known fluoroaromatic polymers are outlined and where possible, the polymers themselves are compared with their hydrocarbon counterparts. A systematic and rapid evaluation of the possibilities of fluoroaromatic polymers is suggested. Author

N65-20741# Royal Aircraft Establishment, Farnborough (England).

THE COLORIMETRIC DETERMINATION OF BROMIDE WITH SULPHONEPHTHALEIN DYES

J. R. Webb London, Min. of Aviation, Dec. 1963 21 p refs

(RAE-TN-CPM-43)

The use of certain sulphonephthalein dyes for the colorimetric determination of 0 to 50 micrograms of bromide was investigated. The reaction of bromide with cresol red in the presence of acid bromate was shown to yield repeatable results. Author

N65-20772# Quantum, Inc., Wallingford, Conn.

HIGH TEMPERATURE POLYAMINE RESINS Technical Progress Report, 16 Sep.-15 Dec. 1964

Raymond L. Taylor [1964] 51 p refs

(Contract NObs-90266)

(TPR-3; AD-455106)

Several polyamine and polyimine type resins were prepared using condensation polymerization reactions. Molar ratios of reactants were varied to prepare resins with various degrees of solubility and moldability. The polyamines were found resistant to many chemicals and solvents; they are least resistant to mineral acids. From the standpoint of thermal stability, polyimines stable up to 700° F are superior to polyamines which show weight losses of 10% to 20% in 24 hours at 600° F. Polyimines are infusible and insoluble. Carborane and neocarborane were synthesized and infrared analyses characteristic of these materials were obtained. Derivatives of these materials which can be incorporated into polyamine resins were prepared. Author

N65-20818 California Univ., Santa Barbara. Physics Dept.
EMISSION FROM THE REACTIONS OF VOLATILE SILICON COMPOUNDS WITH ACTIVE NITROGEN
K. Schofield *In its* Quant. Studies by Opt. Spectry. of Energy Exchange Mech. in Simple Gases and Solids 1 Jan. 1965 p 4–11 refs (See N65-20817 10-23)

Using an atomic flame technique, more detailed studies of some of the initial findings resulting from the addition of volatile silicon compounds to active nitrogen were pursued. These studies were centered on photographic and high-resolution photoelectric emission detectors in the 2000 to 9000 Å region. Efforts were made to observe any spectral dependences on the system's variables, such as working pressure, flow rate, concentration of additive, etc. Following the preliminary findings, the additives used have been $SiCl_4$ and $SiBr_4$, the former giving rise to two systems of SiN and a yet unassigned green system, while the latter gives an interesting gaseous orange system emission, as yet unreported. Established systems were studied in detail, while efforts are being made, with the newly observed systems, to correctly assign them to the emitting molecules, establish the electronic transitions involved, carry out a vibrational numbering of the individual bands, and observe the rotational structure of any bands of sufficient intensity for such an analysis. By adding $GeCl_4$ to discharged nitrogen, a spectrum of GeN previously unreported was obtained. Author

N65-20820 California Univ., Santa Barbara. Physics Dept.
VIBRALUMINESCENCE OF CO_2, N_2O, AND CO IN ACTIVE NITROGEN
E. L. Milne (GM Defense Res. Labs., Santa Barbara) and J. L. Dunn *In its* Quant. Studies by Opt. Spectry. of Energy Exchange Mech. in Simple Gases and Solids 1 Jan. 1965 p 15–17 refs (See N65-20817 10-23)

Addition to a stream of active nitrogen, of CO_2, N_2O, or CO causes near-infrared emission corresponding to the vibrational fundamentals of these added molecules. Excitation of these infrared active gases was studied in the Lewis–Rayleigh orange and pink afterglows of nitrogen. The energy source of the excitation was determined to be vibrationally excited molecules of $N_2(X\,^1\Sigma_g^+)$. Author

N65-20824 California Univ., Santa Barbara. Physics Dept.
A SPECTROSCOPIC STUDY OF THE CHARGE TRANSFER MECHANISMS IN BENZENE IODIDE
J. S. Margolis *In its* Quant. Studies by Opt. Spectry. of Energy Exchange Mech. in Simple Gases and Solids 1 Jan. 1965 3 p (See N65-20817 10-23)

An attempt is underway to investigate the visible and near ultraviolet spectrum of iodine–benzene complexes. The investigation will use single crystals or clear polycrystals of the solid material. Investigations will be made over a temperature range which extends from room temperature to liquid helium temperatures. Author

N65-20845# European Atomic Energy Community, Brussels (Belgium).
THERMAL STABILITY OF URANIUM TRICHLORIDE
C. Hardy-Grena Dec. 1964 26 p refs In FRENCH; ENGLISH summary
(EUR-2189.f) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 40 Belg. Fr.

The thermal stability of UCl_3 was investigated in the temperature range 750° to 900° C. From this study is was concluded that UCl_3 decomposes

$$4\langle UCl_3\rangle \rightarrow 3(UCl_4) + \langle U\rangle .$$

The vapor pressure was determined, and thermochemical data were calculated. Author

N65-20846# Central Lab. TNO, Delft (Netherlands).
SYNTHESIS OF TRITIATED CHLORAMPHENICOL EXCLUSIVELY LABELED IN THE AROMATIC NUCLEUS
P. Otto Brussels, EURATOM, Dec. 1964 27 p refs
(Contract EURATOM-035-62-10 RISN)
(EUR-2196.e) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 40 Belg. Fr.

Chloramphenicol, tritiated by the Wilzbach method, contains the radioactivity distributed over the hydrogen atoms in the benzene nucleus and directly bonded to carbon in the propane side chain. Its use is limited, however, by exchange reactions with protein and randomization of tritium which is due probably to tritium in the side chain, the tritium in the benzene nucleus being expected to form a stable label as a result of the deactivating influence of the nitrogroup. Moreover, it is found that in the organism chemical reactions take place by which the side chain is altered. Tritium in the side chain could be split off by these chemical reactions and introduced into other molecules. Consequently it is of interest to synthesize chloramphenicol exclusively tritiated in the aromatic nucleus. Possibilities for a synthesis of tritiated chloramphenicol labeled exclusively in the aromatic nucleus were investigated. The synthesis of tritiated chloramphenicol of high specific activity is described. Author

N65-20852# India. Dept. of Atomic Energy, Bombay. Chemistry Div.
STUDIES ON THE PREPARATION OF HIGH PURITY ANTIMONY
R. Krishna Iyer and T. R. Bhat 1964 15 p refs
(AEET/CD/34)

The method given for preparation of high purity antimony consists of conversion of the commercial metal to the trichloride by chlorination, distillation of the chloride with hydrochloric acid and subsequent rectification, conversion of the chloride to the oxide, reduction of the oxide to the metal with hydrogen, followed by vacuum rectification of the metal. Each step was studied in detail and the optimum conditions were established. The metal prepared was found to be suitable for semiconductor applications. Author

N65-20854# India. Dept. of Atomic Energy, Bombay. Spectroscopy Div.
SPECTROGRAPHIC ANALYSIS OF HIGH PURITY Gd_2O_3 AND Dy_2O_3 FOR TRACE AMOUNTS OF OTHER RARE EARTHS
S. V. Grampurohit and Smt. K. Swamy 1964 15 p refs
(AEET/SPEC/14)

An emission spectrographic method is described for the analysis of Sm, Eu, Tb, and Dy in gadolinium oxide and Tb,

Ho, Er, and Y in dysprosium oxide. Using dc arc excitation, the spectra are photographed on a 3.4-meter Jaco–Ebert grating spectrograph having a 30000 lines/inch grating. The concentration ranges covered are Sm 0.02% to 0.5%, Eu 0.01% to 0.06%, Tb 0.04% to 0.5%, and Dy 0.03% to 0.5% in Gd_2O_3 matrix and Tb 0.025% to 0.25%, Ho 0.05% to 0.5%, Er 0.008% to 0.5%, and Y 0.03% to 0.8% in Dy_2O_3 matrix. Author

N65-20886# Princeton Univ., N. J. Frick Chemical Lab.
RAMAN SPECTRUM OF CRYSTALLINE AND LIQUID SO_2 Technical Report No. 18
A. Anderson and R. Savoie Jan. 1965 18 p refs
(Contract Nonr-1858(27))
(NR-019-143; AD-610365)

The Raman spectrum of crystalline sulfur dioxide was recorded at several temperatures between 9° and 185° K. The main features are in accord with those predicted from the factor group analysis for the known structure of the crystal. Additional peaks were also observed, some arising from isotopic species and lattice fundamentals. As an aid to the assignment of several other bands, the spectrum of the liquid was also recorded to distinguish the specifically crystalline features. Possible causes of these extra peaks, such as combinations with lattice modes, crystalline defects, and impurities are briefly discussed. Author

N65-20886*# Atomics International, Canoga Park, Calif.
SOLUBILITY AND DIFFUSION STUDIES OF ULTRA PURE TRANSITION ELEMENTS IN ULTRA PURE ALKALI METALS Sixth Quarterly Report, Oct. 4, 1964–Jan. 2, 1965
R. L. Mc Kisson and R. L. Eichelberger 5 Mar. 1965 27 p refs
(Contract NAS3-4163)
(NASA-CR-54096; AI-65-15) CFSTI: HC $2.00/MF $0.50

Techniques for effecting a diffusion bond seal between the collector and the crucible are being tested and evaluated. Tentative values of the solubility of very pure iron in potassium from the present series of tests are 17 wppm at 800° C, and 100 wppm at 1000° C. The results of the tests indicate the solubility in potassium of ultrahigh purity iron is substantially lower than that of Armco iron, but the temperature dependencies of solubility of the two sets of data appear to be nominally equal. One excellent molybdenum single crystal crucible has been received and is being readied for testing. The crucibles not yet delivered are: one molybdenum; one niobium; and two tantalum. The current batch of potassium shows metallic impurity levels lower than those of the normally available high-purity standard materials. The only metallic elements detected spectroscopically are: <1 ppm Ag, <1 ppm Mg, 10 ppm Na, and <5 ppm Si. Author

N65-20900# Pennsylvania Univ., Philadelphia. Electrochemistry Lab.
REVERSIBLE OXYGEN ELECTRODES Quarterly Report, 1 Jul.–30 Sep. 1964
M. Genshaw, V. Brusic, and A. Damjanovic [1964] 43 p refs
(Contract DA-36-039-SC-88921)
(QR-11; AD-459568)

A rotating disk electrode with a ring is used in the study of the mechanism of the oxygen dissolution reaction. It was shown that the plot of the ratio of the current on the disk to that on the ring electrode vs $\omega^{-1/2}$, where ω is the rate of electrode rotation, is characteristic of the mechanism of oxygen reduction on the disk electrode. It was shown in preliminary experiments using the above plot that, in acid solution, reduction of oxygen occurs by two parallel paths, one producing H_2O_2 as a stable product, the other producing water. Hydrogen peroxide is not further reduced to water. The amount of H_2O_2 produced is a function of potential. At less cathodic potentials ($V > \approx 0.8V$) the yield of H_2O_2 appears to be small. In alkaline solution, oxygen reduction involves H_2O_2 as an intermediate which reduces further to H_2O but with the rate independent of potential in the range (0.6–0.8 V vs H_2 electrode in the same solution). A study of the catalytic activity for the reaction on a number of metals and alloys is in progress. Author

N65-20903# Oxford Univ. (England). Clarendon Lab.
EPR AND ENDOR OF Tb^{4+} IN THORIA Scientific Report No. 6
J. M. Baker, J. R. Chadwick, G. Garton, and J. P. Hurrell Dec. 1964 40 p refs Submitted for Publication
(Contract AF 61(052)-677)
(AFCRL-65-113; AD-459504)

The EPR and ENDOR spectra were measured in ThO_2 containing Tb^{4+}. The crystalline electric field is cubic, and the splittings are very large compared with other S state ions. There are very marked differences between the parameters in the standard cubic spin-Hamiltonian and those for the other S state ions Gd^{3+} and Eu^{2+}. These differences are probably due to covalent bonding. Author

N65-20905# Aerospace Corp., El Segundo, Calif.
THE COMBINATION OF CF_2 FROM THE GLOW DISCHARGE OF CF_4
Norman Cohen and Julian Heicklen 30 Dec. 1964 24 p refs
(Contract AF 04(695)-469)
(TDR-469(9240-01)-2; SSD-TDR-64-280; AD-457749)

In a flow system, tetrafluoromethane was passed through an electrodeless discharge to produce CF_2 radicals, believed to be triplets. Ethylene injected downstream of the discharge reacted completely with the CF_2 radicals present to produce C_3 compounds in a chemiluminescent reaction. Thus, the CF_2 concentration could be monitored both optically and chemically as the mixture flowed down the glow tube. The chemiluminescent species was found to have a lifetime of 1.0×10^{-2} sec. The value of the combination rate constant was estimated to be 0.9×10^8 liter/mole-sec. Author

N65-20921# Little (Arthur D.), Inc., Cambridge, Mass.
STUDY OF HIGH TEMPERATURE THERMODYNAMICS OF LIGHT METAL COMPOUNDS Progress Report No. 12, 1 Oct.–31 Dec. 1964
Alfred Büchler 31 Dec. 1964 9 p refs
(Contract DA-19-020-ORD-5584; ARPA Order 40-62)
(C-64362; AD-459569)

In the $BeO–B_2O_3$ system it was found that BeB_2O_6(c) is the only condensed-phase mixed oxide present at high temperatures. From microbalance experiments and other data, 23 ±5 kcal/mole was derived as an improved value for the heat for formation of gaseous beryllium metaborate from its constituent oxides. Mass spectra, ionic species, and current are reported for the $NaF–AlF_3$ system, from twin-crucible experiments. A method is proposed for determining the precursor of Na_2AlF^+. In studies of molecular structure it was shown that rhenium trichloride is trimeric in the vapor phase, as well as in solution and in the crystalline form. J.M.D.

N65-20930# Instituto Superiore di Sanita, Rome (Italy).
SPECTROCHEMICAL ANALYSIS OF NON METALS IN THE VACUUM ULTRAVIOLET BY MEANS OF A HOLLOW CATHODE LIGHT SOURCE Final Report, 1 Jan.–31 Dec. 1964
Giulio Milazzo and Mello Sopranzi [1965] 32 p
(Contract DA-91-591-EUC-3187)

Systematic investigations were made of the limit of detectability of iodine using two of its most sensitive resonance lines in the vacuum ultraviolet, i.e., 1830.4 and 1782.8 Å. These limits were found to be practically independent of whether iodine was present as a pure substance, as potassium iodide, or as an impurity in potassium chloride. These limits are not critically sensitive to the nature of the carrier gas tested (helium and argon) and its pressure. The detectability limit expressed as elemental iodine was found to be 3×10^{-7}g where the maximum current intensity was 300 mA and the exposure was 5 minutes. Investigations were made on the reproducibility of photographic blackening differences for spectral lines of various elements in the same matrix, excited in the hollow cathode, where different kinds of photographic plates were used. Results based on the constancy of blackening differences between two suitably chosen lines, one of copper and another of zinc, emitted by a brass cathode fully confirm the general utility of this light source in this spectral region. The variation of the result was the same order of magnitude encountered in classical quantitative spectrochemical analysis utilizing the conventional spark, prism spectrograph, and quartz ultraviolet region. Author

N65-20931# Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.
DEPOSITION OF SILICON ON INSULATING SUBSTRATES Scientific Report No. 1, Jul. 1–Dec. 31, 1964
T. L. Chu, G. A. Gruber, J. J. Oberly, and R. L. Tallman [1964] 62 p refs
(Contract AF 19(628)-4220)
(AFCRL-65-52; AD-458662)

The pyrolysis of silane and the vacuum evaporation of silicon were used for the deposition of silicon films on various substrates. These techniques could minimize autodoping and diffusion effects. Silicon films deposited on silicon substrates were of good crystal perfection, similar to that of the substrates. Silicon films deposited on sapphire and silicon carbide substrates were found to be epitaxial with respect to the substrates. Epitaxial silicon films of a few hundred Angstroms thickness were also deposited on silicon carbide substrates by vacuum evaporation. The apparatus and procedures of the deposition processes and the evaluation of the silicon films are discussed. Exploration of new substrate materials, particularly those in the form of films deposited on silicon and other substrates, was carried out. The deposition processes and the properties of these films are discussed. Author

N65-20950# Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf (Austria). Reaktorzentrum
NONDESTRUCTIVE ANALYSIS OF IMPURITIES IN PURE NIOBIUM THROUGH NEUTRON ACTIVATION AND GAMMA SPECTROMETRY [ZERSTORUNGSFREIE BESTIMMUNG VON VERUNREINIGUNGEN IN REINNIOB DURCH NEUTRONENAKTIVIERUNG UND GAMMASPEKTROMETRIE]
J. Grosel and H. Sorantin [1964] 20 p refs Submitted for Publication
(SGAE-CH-11/1964)

Niobium dust in plastic containers underwent irradiation of 1.3×10^{13} n/cm^2 sec for periods of 1 min, 5 min, and 10 min. The obtained γ-spectra showed the typical peaks of Nb^{94m} (half-value life 6.6 min) at 0.042 and 0.847 MeV for the 1-min period, new lines with half-value life of 24 hrs of W^{187} for the 5-min irradiation, and peaks at 1.28 MeV of A^{41}, and 1.81 MeV of Mn^{56} after the 10-min irradiation. The 9-hr irradiation of the niobium dust in a quartz container established a double line for Ta^{182} at 1.12 and 1.21 MeV with a half-value life of 100 days. Irradiation of 150-mg niobium dust mixed with either 1.45- or 2.55-mg Ta, which corresponds to an approximate Ta content of 100 ppm, resulted in 1999 ±66 ppm Ta. Four irradiations of a W^{187} and Nb^{94m} mixture gave mean values of 1353 ±10 ppm. The activation of Nb^{94m} and Mn^{56} mixtures produced only a weak Mn^{56} peak at 1.81 MeV. G.G.

N65-20954# California Univ., Berkeley. Lawrence Radiation Lab.
BIO-ORGANIC CHEMISTRY ANNUAL REPORT, DECEMBER 1963–DECEMBER 1964
Melvin Calvin et al 9 Feb. 1965 39 p refs
(Contract W-7405-ENG-48)
(UCRL-11948) CFSTI: $2.00

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N65-20974# Oak Ridge National Lab., Tenn. Chemical Technology Div.
DISSOLUTION OF HIGH-DENSITY UO_2, PuO_2, AND UO_2–PuO_2 PELLETS IN INORGANIC ACIDS
Armando L. Uriarte and Robert H. Rainey Apr. 1965 84 p refs
(Contract W-7405-ENG-26)
(ORNL-3695) CFSTI: $3.00

A laboratory study was made of the initial instantaneous dissolution rates (IDR) and total dissolution times of unirradiated, commercially prepared UO_2, PuO_2, and PuO_2–UO_2 pellets in boiling nitric acid alone and with additives. The UO_2 dissolved readily in nitric acid alone; PuO_2 dissolved slowly even with the addition of fluoride. Pellets containing as much as 28% PuO_2 in UO_2 dissolved in nitric acid alone when fabrication procedures indicated that solid solutions were formed, but part of the plutonium remained undissolved from pellets which were probably not solid solutions. Since the present state of the art of pellet fabrication does not ensure that the plutonium will be in solid solution in all pellets, and since complete dissolution of plutonium is required in commercial fuel processing, the use of fluoride for the dissolution of PuO_2–UO_2 pellets is indicated. Author

N65-21014# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DEPARTMENT OF GENERAL AND TECHNICAL CHEMISTRY LECTURE
A. N. Nesmeyanova 26 Feb. 1965 17 p Transl. into ENGLISH from Vestn. Akad. Nauk SSSR (Moscow), no. 4, 1964 p 98–105
(FTD-TT-64-881/1; AD-611863)

Chemistry is discussed from two viewpoints: (1) greater chemistry—those materials which are produced in large quantities in the chemical industry, and (2) small chemistry—a great number of chemicals produced in small quantities. The emphasis in greater chemistry is on methods of producing the most at the least cost. In smaller chemistry, the substance and its specific properties, structure, and synthesis are the important considerations. E.E.B.

N65-21022# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
DETERMINATION OF THE STRUCTURE OF ORGANIC COMPOUNDS BY MEANS OF CHROMATOGRAPHY. FUNCTION R_m AS THE BASIS OF STRUCTURAL ANALYSIS BASED ON CHROMATOGRAPHY
Zelimir Prochazka [1964] 49 p refs Transl. into ENGLISH from Chem. Listy (Prague), v. 58, 1964 p 911–945
(RSIC-390; AD-612879)

Structural analysis by means of chromatography is outlined. The substance is located on the paper. If the substance is not colored or fluorescent it must first be developed by means of a nonspecific agent, such as iodine vapor, sulfuric acid, or carbonization. When the substance has been located, a series of chromatogram strips are prepared by spraying them successively with more specific agents, and results recorded. Detailed procedures are included. Among the specific agents discussed are acids and bases; alkaloids; amino acids; aromatic amines, pyrrols, indoles, and imidazoles; purines and pyrimidines; esters; phenols; sugars; and nitro compounds. The structure of organic compounds can also be determined by measuring and analyzing the R_f values of the substance using chromatography. This method is discussed in detail. E.E.B.

N65-21023# Brussels Univ. (Belgium).
VAPORIZATION OF COMPOUNDS AND ALLOYS AT HIGH TEMPERATURES. PART XXVI: MASS SPECTROMETRIC STUDY OF THE VAPORIZATION OF LEAD MONOXIDE. THE DISSOCIATION ENERGY OF PbO
J. Drowart, R. Colin, and G. Exsteen Wright-Patterson AFB, Ohio, AF Mater. Lab., Dec. 1964 21 p refs
(Contracts AF 61(052)-764; AF 61(052)-225)
(WADD-TR-60-782, Pt. XXVI; AD-612780)

The composition of the vapor in equilibrium with lead oxide (yellow rhombic form) in the temperature interval 1000° to 1150° K was determined mass spectrometrically. The predominant species are PbO, Pb_2O_2, Pb_3O_3 and Pb_4O_4. From the partial PbO pressure measured here, and that based on a reinterpretation of the literature data, when taking the presence of the polymers into account, the dissociation energy of the molecule PbO was calculated: D°_0 (PbO) = 88.4 ±1.4 kcal/mole. Author

N65-21043# General Electric Co., Philadelphia, Pa. Space Sciences Lab.
EFFECTS OF CONTAMINANTS ON OBSERVABLES IN RE-ENTRY Third Quarterly Technical Report
Walter E. Kaskan 18 Feb. 1965 16 p refs
(Contract DA-31-124-ARO(D)-214; ARPA Order 553)
(AROD-5737-3; AD-457852)

Calculations of sodium ionization rates were made using a system with three electron states, whose effect on the overall rates is illustrated and analyzed. The atmospheric pressure burner system was converted into a second low pressure facility to reduce the work load on the large facility. Work on chemiluminescence of Na in flames was started in this new facility. Data are shown from a typical run on a sodium seeded H_2–CO–air flame at 50 mm, in which chemiluminescence of Na is clearly indicated. The infrared spectrum of the vapor in equilibrium with sodium oxide with and without excess oxygen was observed in solid krypton matrices. There appears to be a definite indication of a peroxide-type bonding in the spectrum obtained with excess oxygen. Whether this is due to the dimer Na_2O_2 or to the dioxide NaO_2 is still uncertain. Author

N65-21063# University Coll. of Wales, Aberystwyth. Edward Davies Chemical Lab.
SPECTROSCOPIC STUDIES: PART V, THE SPECTRA AND STRUCTURE OF MONOHALOGENO-ACETONITRILES Scientific Report No. 12
R. G. Jones and W. J. Orville-Thomas 17 Nov. 1964 43 p refs
(Contract AF 61(052)-691)
(AFCRL-65-135; AD-612166)

The infrared spectra of a closely related series of acetonitriles were obtained between 5000 and 500 cm^{-1}. An analysis of the fine structure obtained for two fundamentals of fluoroacetonitrile and of band contours in other cases shows that the molecules have the nitrile structure, XCH_2CN (X = halogen) and not the alternative ketimine structure XCH = C = NH. Frequency assignments were made and structural details deduced in each case. The spectroscopic data were used to calculate thermodynamic data for FCH_2CN and $ClCH_2CN$. Author

N65-21064# Cornell Univ., Ithaca, N. Y. Dept. of Chemistry
COLLISION BROADENING OF OH EMISSION LINES, MEASURED IN THE INFRARED Technical (Scientific) Note No. 11
S. H. Bauer and J. H. Jaffe (Weizmann Inst. of Science) Nov. 1964 26 p refs
(Contract AF 61(052)-388)
(AFCRL-65-133; AD-612294)

The OH emission spectrum from an H_2/O_2 flame was recorded in the infrared, for the (1,0) vibrational transition of the ground $^2\pi_1$ state. The spectral region covered was 3.18μ to 3.65μ (four lines each for P(10) to P(18)). Use of a high resolution spectrometer with a slit width (full width at half maximum) of 0.06 cm^{-1} to 0.04 cm^{-1} allowed the direct estimation of line widths, which ranged from 0.11 cm^{-1} for the P(10) lines to 0.08 cm^{-1} for the P(18) lines. The deduced collision line widths for the fundamental vibrational band in the ground state are larger than expected on the basis of comparable data for HCl,

and are about five times greater than those reported for the (0,0) band of the $^2\Sigma \leftarrow {}^2\pi_i$ transition, measured in the ultraviolet. A theoretical estimate of the dipole-induced dipole, dispersion forces and hard-core contributions to the OH line width, under flame conditions, gave a value of ≈ 0.03 cm^{-1}. Author

N65-21065# Republic Aviation Corp., Farmingdale, N. Y.
APPLICATION OF DIFFERENTIAL SPECTROPHOTOMETRY TO THE STOICHIOMETRY OF ELECTRONIC MATERIALS Final Report, May 1, 1962–Dec. 14, 1964
R. S. Kelly, A. Eldridge, E. W. Lanning, and R. Bastian 14 Mar. 1965 83 p refs
(Contract AF 19(628)-441)
(AFCRL-65-50; AD-612284)

Spectrophotometric methods were developed for the analysis of gallium arsenide and bismuth telluride for their major elements, with a precision suitable for stoichiometry studies. Analyses are presented of synthetic and actual samples of the compounds, including total analyses of gallium arsenide prepared under various arsenic pressures. Some gallium arsenide samples are very close to theoretical in composition, while one sample made under excess arsenic pressure shows an excess of this element in the main body of the ingot. Segregation of the elements in the tail sections of the ingots is evident. Methods for the analysis of gallium arsenide may be utilized to see if a correlation can be established between major composition and electronic properties such as laser action. Author

N65-21066# India. Dept. of Atomic Energy, Bombay. Chemistry Div.
PREPARATION AND STRUCTURAL CHARACTERISTICS OF δ-U_3O_8—A HIGH TEMPERATURE MODIFICATION
M. D. Karkhanavala, A. M. George, and V. Amirthalingam 1964 14 p refs
(AEET/CD/23)

The U_3O_8 obtained by the method of Notz et al, is now designated δ–U_3O_8. The yield of δ–U_3O_8 is found to be highly dependent on the soaking temperature, the optimum being 1350°C. The δ–U_3O_8 were studied by differential thermal analysis and X-ray diffraction methods. The X-ray investigations on powders gave an orthorhombic cell of a = 6.70 Å, b = 12.46 Å, and c = 8.53 Å. Single crystal data show a smaller cell—a = 6.70 Å, b = 4.14 Å (~1/3b powder) and c = 8.53 Å, space group $C_{cc}2$ and Z = $4UO_{2.67}$. Author

N65-21067# India. Dept. of Atomic Energy, Bombay. Technical Physics Div.
PREPARATION OF EUROPIUM ACTIVATED LITHIUM IODIDE SCINTILLATION CRYSTALS
K. K. Devgan 1964 12 p refs
(AEET/TP/4)

Europium-activated lithium iodide single crystal is an efficient detector for slow neutrons. Details of the process developed for the preparation of anhydrous lithium iodide and its subsequent growth into large single crystals are presented and their response to slow neutrons is shown. Satisfactory performance was observed with the crystals. Author

N65-21071# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
DETERMINATION OF HYDROGEN IN ZIRCONIUM ALLOYS BY ISOTOPIC EQUILIBRATION
R. W. Ashley and A. S. Denovan Feb. 1965 12 p refs
(CRDC-1212; AECL-2202) Available from Atomic Energy of Canada, Chalk River: $0.50

A method is described for the determination of hydrogen in zirconium alloys by equilibration of a sample with deuterium gas at an elevated temperature and measurement of the resulting isotopic dilution by mass spectrometry. The method is rapid and simple. The precision and accuracy over a wide range of sample size and hydrogen concentration are equal to those obtained by vacuum extraction or fusion methods. Comparative results are given for standard samples. Author

N65-21072# Royal Aircraft Establishment, Farnborough (England).
MASS SPECTROMETRIC EXPERIMENTS OF THE FIELD IONISATION OF WATER VAPOUR FROM TIPS OF TUNGSTEN PLATINUM AND IRIDIUM [MASSENSPEKTROMETRISCHE UNTERSUCHUNG DER FELDIONISATION VON WASSERDAMPF AN SPITZEN AUS WOLFRAM, PLATIN UND IRIDIUM]
W. A. Schmidt Dec. 1964 20 p refs Transl. into ENGLISH from Z. Naturforsch. (Tubingen), v. 19a, no. 3, Mar. 1964 p 318–327
(RAE-LIB-TRANS-1091)

The ion current increased sharply at a limiting field strength characteristic of the system (W tip/H_2O–20 MV/cm; Ir tip/H_2O–51 MV/cm; Pt tip/H_2O–61 MV/cm). The variations of the spectra with field strength were investigated systematically—tips always at room temperature. In the system W/H_2O in addition to known ions of the form H_3O^+ $(H_2O)_n$, n = 0, 1, 2, 3 there were ions of tungsten oxide in various oxidation and ionization states both solvated and unsolvated. In Pt/H_2O and Ir/H_2O at the initial field strengths the ions H_3O^+ $(H_2O)_n$, n = 0, 1, 2 were detected. At higher field strengths H_2O^+ and O_2^+ also appeared, but no metal oxide ions did. The sharp increase in ion current may be attributed to conditions necessary for the existence of the tunnel effect. At the initial field strength the ionization probability of water was already nearly unity. The reaction mechanism of the field ionization of H_2O which according to the experimental results covers the tips as a multimolecular adsorption layer was discussed as was the dependence of the intensity of the various ions on field strength. Author

N65-21085*# Uppsala Univ. (Sweden). Physics Dept.
HIGHLY IONIZED SPECTRA OF NITROGEN AND OXYGEN Status Report No. 5, 1 Dec. 1964–28 Feb. 1965
Kjell Bockasten, J. Bromander, R. Hallin, and B. Johansson [1965] 9 p ref
(Contract NASr-174)
(NASA-CR-57850) CFSTI: HC $1.00/MF $0.50

Calculations of the unperturbed energy levels of NV are presented in a table for all levels with $n \leq 10$. The Stark effect displacements for different m-values have been calculated as functions of the electric field for terms with $n = 4 - 7$ and $1 \geq 2$, and the results are presented in graphs showing the position of the states versus field strength. The displacements of the energy levels were obtained from the Stark effect calculations for a field strength of 30 kV/cm. The displacements of the transition $4d - 5f$ are considerable and cannot be explained by Stark effect calculations using hydrogenic wave functions, in contrast to the much smaller displacements of the transition $4f - 5g$. The same effect for the corresponding transitions in CIV (2524 and 2529 Å) has been observed from discharges in ethylene. G.G.

N65-21088# India. Dept. of Atomic Energy, Bombay. Spectroscopy Div.
ISOTOPIC ASSAY OF BORON-10 IN BORON TRIFLUORIDE BY SPECTROSCOPIC METHOD

S. L. N. G. Krishnamachari and B. R. Vengsarkar 1964 13 p refs
(AEET/SPEC/12)

To determine the B^{10} isotopic concentration by the molecular spectroscopic method, it is necessary to obtain a molecular spectrum containing a boron atom which would give an appreciable B^{10}–B^{11} isotopic shift. A strong emission spectrum was found for the BO_2 radical. The band head at 5457 Å showed a considerable isotopic shift of about 22 cm^{-1}. Since the spectrum could be obtained with great intensity using very small amounts of BF_3 and also because the isotopic heads could be well separated even on a medium dispersion instrument, it was found suitable for the determination of B^{10} concentration in enriched BF_3 samples. The standard deviation varied from 1.7 to 2.7 in the concentration range of 20% to 90% B^{10}. It was concluded that the method presented can be used as an absolute method for the determination of B^{10} concentration in enriched BF_3 samples. E.E.B.

N65-21113# Los Alamos Scientific Lab., N. Mex.
DETERMINATION OF BORIC ACID IN ADMIXTURE WITH CYANURIC ACID
Raymond N. Rogers 23 Feb. 1965 18 p refs
(Contract W-7405-ENG-36)
(LA-3193) CFSTI: $1.00

Boric acid can be separated from cyanuric acid by methanol vapor distillation. Procedures for the separation and for a coulometric titration of the boric acid are described. Consistent recoveries of greater than 99.7% with a standard deviation of ±0.21% are obtained. Author

N65-21120# Hahn-Meitner-Institut für Kernforschung, Berlin (West Germany).
RELEASE OF XENON FROM POLYCRYSTALLINE URANIUM MONOCARBIDE (RARE-GAS DIFFUSION IN SOLIDS 17)
P. Schmeling Brussels, EURATOM, 1964 39 p refs
(Contract EURATOM-028-64-1 TEED)
(EUR-1752.e; EURAEC-1076) Available from Belg. Am. Bank and Trust Co., New York, Account no. 22.186: 60 Belg. Fr.

Polycrystalline uranium monocarbide samples of four different materials were investigated and the release of xenon was studied in a number of postirradiation experiments. Nonideal gas release was observed in nearly all cases. An initial burst of activity was probably due to the liberation of recoil-induced xenon. A solid–solid reaction between specimen and container material was observed in some cases and caused an enhanced gas release. The diffusion coefficient was found to differ within each group of material, and a number of experiments were performed in order to show the fluctuations. The diffusion coefficients for all investigated materials appeared to fall within the same region, and all investigated materials had approximately the same diffusion coefficient at the same temperature; the fluctuations between the groups were less than the variation within each group. The activation energy for xenon diffusion showed little variation between the groups with a mean value of 67 kcal/mole and an estimated probable error of ±12 kcal/mole. Author

N65-21122# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research
HOT PHOSPHORUS ATOM REACTIONS IN LIQUID ORGANIC MIXTURES
Andrzej Siuda Nov. 1964 17 p refs Presented at the Symp. on Chem. Effects Assoc. with Nucl. Reactions and Radioact. Transformations, Vienna, 7–11 Dec. 1964
(Rept.-576/V)

The effect of the organic diluents on the yield of ^{32}P-labelled phenylphosphonic acid formed in 1-M benzene solutions of phosphorus trichloride as a result of the $^{31}P/n$, gamma/^{32}P reaction was investigated. The yield of phenylphosphonic acid decreases linearly with the increase in cyclohexane mole fraction. On the other hand, with carbon tetrachloride dilution the yields of phenylphosphonic acid are greater than one could expect from the composition of the mixtures. The results show that the reactions between the recoil phosphorus atoms and the benzene molecules resulting in phenylphosphonic acid can be affected by surrounding molecules. Author

N65-21131# California Inst. of Tech., Pasadena. Div. of Chemistry and Chemical Engineering
MAGNETIC RESONANCE SPECTROSCOPY: THE CONFIGURATIONAL STABILITY OF PRIMARY GRIGNARD REAGENTS. 3,3-DIMETHYLBUTYLMAGNESIUM CHLORIDE
George M. Whitesides, Michal Witanowski, and John D. Roberts Dec. 1964 45 p refs Submitted for Publication
(Contract Nonr-220(26))
(TR-39; AD-455119)

Detailed examination of the temperature dependence of the n.m.r. spectra of 3,3-dimethylbutylmagnesium chloride and bis-(3,3-dimethylbutyl)-magnesium indicates that inversion of configuration at the $—CH_2—Mg$ center occurs rapidly in either solution at room temperature. Activation parameters for the inversion reactions are $E_a = 11 \pm 2$ kcal/mole, $A = 10^{8.5 \pm 1.5}\ sec^{-1}$, and $E_a = 20 \pm 2$ kcal/mole, $A = 10^{13.5 \pm 1.5} sec^{-1}$, respectively. Author

N65-21138# Oak Ridge National Lab., Tenn. Chemical Technology Div.
ADSORPTION OF PROTACTINIUM ON UNFIRED VYCOR: INITIAL HOT-CELL EXPERIMENTS
J. G. Moore, J. H. Goode, J. W. Ullmann, R. H. Rainey et al Apr. 1965 23 p refs
(Contract W-7405-ENG-26)
(ORNL-3773) CFSTI: $2.00

A process for recovering ^{233}Pa by adsorbing it on unfired Vycor glass was demonstrated using thorium–uranium fuel specimens that were irradiated to 75 000 MWd/metric ton in an average neutron flux of 2×10^{14} and allowed to decay 26 days. Over 99% of the fuel dissolved in refluxing 13 M HNO_3–0.05 M HF, leaving a residue containing less than 0.1% of the uranium and up to 20% of the protactinium. The protactinium losses could be minimized by cyclic dissolution in a process application. Several gross inconsistencies were observed in results from protactinium analyses. These difficulties indicate that the analytical procedures for protactinium and the stability of solutions containing protactinium in the presence of macro concentrations of fission products need to be reinvestigated. Further hot-cell experiments will be necessary to determine the capacity of unfired Vycor and the maximum protactinium concentration factors obtainable with the process. Author

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N65-20206 Joint Publications Research Service, Washington, D. C.

ABSORPTION OF RADIO-EMISSION AT 70.16 CM WAVELENGTH IN THE ATMOSPHERE

D. A. Dmitrenko, V. D. Krotikov, V. S. Troitskiy, and N. M. Tseytlin *In its* Izv. VUZov: Radiophys., Vol. VII, No. 5, 1964 11 Mar. 1965 p 1–8 refs (See N65-20205 10-10) CFSTI: $6.00

Results of absorption measurements in the atmosphere are presented, based on its own radiation at the 70.16-cm wavelength. The optical thickness of the vertical atmospheric layer is shown to be $9.2 \times 10^{-3} \pm 15\%$. Author

N65-20212 Joint Publications Research Service, Washington, D. C.

ON THE CHARACTERISTICS OF UNBALANCED RADIATION AND THERMODYNAMIC REVERSIBLE CONVERTERS

S. I. Borovitskiy and V. V. Mityugov *In its* Izv. VUZov: Radiophys., Vol. VII, No. 5, 1964 11 Mar. 1965 p 56–72 refs (See N65-20205 10-10) CFSTI: $ 6.00

Expressions are derived for the entropy of unbalanced electromagnetic radiation; they are obtained on the basis of operational determination of entropy. General characteristics of thermodynamic reversible converters of radiation are formulated and illustrated in a series of examples. Author

N65-20213 Joint Publication Research Service, Washington, D. C.

PROBABILITY DISTRIBUTION OF THE POSITION IN TIME OF THE THRESHOLD POINT OF A SIGNAL AT THE DETECTOR OUTPUT IN THE PRESENCE OF NOISE

Yu. A. Medvedev, K. D. Protsenko, and B. M. Stepanov *In its* Izv. VUZov: Radiophys., Vol. VII, No 5, 1964 11 Mar. 1965 p 73–82 refs (See N65-20205 10-10) CFSTI: $6.00

The distribution function of the position in time of the threshold point at the detector output is analyzed, and the root-mean-square deviation is evaluated when the fluctuations are assumed to be small and when Gaussian noise is present at the input. Author

N65-20214 Joint Publications Research Service, Washington, D. C.

DIFFRACTION OF A NORMALLY INCIDENT SURFACE TM-WAVE AT THE BOUNDARY BETWEEN ISOTROPIC AND ANISOTROPIC IMPEDANCE HALF-PLANES

V. G. Myshkin *In its* Izv. VUZov: Radiophys., Vol. VII, No. 5, 1964 11 Mar. 1965 p 83–90 refs (See N65-20205 10-10) CFSTI: $6.00

Two-dimensional Green tensors for an anisotropic impedance half-plane with a symmetrical tensor of surface impedance are utilized in the solution of a diffraction problem in the Kirchhoff approximation: a surface TM wave at the boundary between an isotropic and an anisotropic half-plane (the incident wave is normal to the separating boundary). The general formulas obtained here are applied to calculations in the case where the anisotropic half-plane consists of a ribbed metallic structure with the ribs oriented at any arbitrary angle with respect to the boundary. Author

N65-20215 Joint Publications Research Service, Washington, D. C.

THREE-DIMENSIONAL GREEN TENSORS FOR AN ANISOTROPIC IMPEDANCE PLANE AND DIFFRACTION OF AN OBLIQUELY INCIDENT SURFACE TM-WAVE AT THE BOUNDARY BETWEEN THE ISOTROPIC AND ANISOTROPIC HALF-PLANES

V. G. Myshkin *In its* Izv. VUZov: Radiophys., Vol. VII, No. 5, 1964 11 Mar. 1965 p 91–103 refs (See N65-20205 10-10) CFSTI: $6.00

The three-dimensional electric and magnetic Green tensors are calculated for a half-space bounded by an impedance plane with a symmetric tensor of surface impedance. The problem of the diffraction of a surface TM- wave at the boundary between the isotropic and anisotropic impedance half-planes is solved in the Kirchhoff approximation for the case of oblique incidence; notice is taken of the double refraction of surface waves. The general relations obtained are used for calculations in the special case where one of the half-planes is a retarding ribbed metallic structure; the ribs are oriented at an arbitrary angle with respect to the boundary between both media. The laws of refraction of surface waves are derived and the conditions for a total reflection are determined. Author

N65-20216 Joint Publications Research Service, Washington, D. C.

DIFFRACTION OF A PLANE H-POLARIZED ELECTROMAGNETIC WAVE ON AN ARRAY WITH A SPECIAL GEOMETRICAL CONFIGURATION

L. N. Litvinenko *In its* Izv. VUZov: Radiophys., Vol. VII, No. 5, 1964 11 Mar. 1965 p 104–115 refs (See N65-20205 10-10) CFSTI: $6.00

The article presents a solution to the problem of the diffraction of a plane H-polarized electromagnetic wave normally incident on an ideal array composed of metal strips in a special configuration. Results of numerical calculations for the coefficient of reflection as a function of incident wavelength for various dimensions of array elements are given. Author

N65-20225 Joint Publications Research Service, Washington, D. C.

THE SPECTRUM OF DISTRIBUTED COSMIC RADIO EMISSION IN THE DECAMETER RANGE OF RADIO WAVES

Yu. S. Korobkov *In its* Izv. VUZov: Radiophys., Vol. VII, No. 5, 1964 11 Mar. 1965 p 225–229 refs (See N65-20205 10-10) CFSTI: $6.00

Cosmic radio emission was received by a multidipole-antenna device at frequencies of 40, 25, 18.6, 13, 9, and 6.3 Mc; observations were made at night when the critical frequency of the ionosphere was low. To reduce losses to the ground the antennas were equipped with wire reflectors. It was observed that the intensity of cosmic radio emission reaches a flat section at 8 to 9 Mc and undergoes reduction after that; emission temperature was found to be a uniformly decreasing function of wave frequency; spectral index appeared to be a uniformly increasing curvilinear function of frequency. Explanations are offered for these phenomena. Errors in measurement due to various sources are analyzed; it is suggested that estimation of frequency dependence of spectral index may be obscured by large error. J.M.D.

N65-20226 Joint Publications Research Service, Washington, D. C.

MEASUREMENT OF THE ABSORPTION OF RADIO WAVES IN THE ATMOSPHERE AT A WAVELENGTH OF 3.2 CM

V. P. Lastochkin, K. S. Stankevich, and K. M. Strezhnevа *In its* Izv. VUZov: Radiophys., Vol. VII, No. 5, 1964 11 Mar. 1965 p 230–232 refs (See N65-20205 10-10) CFSTI: $6.00

Absorption of radio waves at wavelength 3.2 cm by atmospheric oxygen and water vapor was determined. For the investigation an antenna 4 meters in diameter, and a radiometer with sensitivity 0.5° K at a time constant of 1 second, were

used. Temperature of the thermal radio emission of the atmosphere was observed at different heights above the horizon. From these data absorption coefficients were determined for oxygen and water vapor. The value for oxygen is 0.054 dB, and 7×10^{-4} dB $\times$ $m^3 \times km^{-1} \times g^{-1}$ for water vapor. J.M.D.

N65-20311# Atomic Weapons Research Establishment, Aldermaston (England).
THE EFFECTS OF HIGH ALTITUDE NUCLEAR EXPLOSIONS ON RADIO COMMUNICATIONS. PART 1: THEORETICAL CONSIDERATIONS
F. L. Hill Mar. 1964 61 p refs
(AWRE-O-7/64)

The ionization produced in the lower ionosphere by X-rays, β particles from neutron decay, β and γ irradiation from fission products from a nuclear burst is examined and evaluated for a range of burst heights. The effects of this increased ionization are related to the attenuation of rf signals. The effects of wave motions in the ionosphere are briefly considered. Author

N65-20320 Westinghouse Electric Corp., Baltimore, Md.
MEASUREMENT OF RELATIVE DEFLECTIONS OF A GROUND MAPPING RADAR ANTENNA IN A VIBRATION ENVIRONMENT
E. F. Dyer *In* NRL Shock and Vibration Bull. Feb. 1965 p 103–106 (See N65-20313 10-14)

This paper describes a monitoring technique in which steel rods are attached to the antenna surfaces, fed through ball bushings, and then attached to movable cores of linear variable differential transformers. The transformer outputs are phase inverted and suitably scaled (if required) and then fed to a simple analog computer, where actual deflections are computed and recorded on a calibrated oscillograph. Relative deflections can be determined to an accuracy of ± 0.002 inch when the test item surface is moving ± 0.5 inch within the 0 to 200-cps frequency range. Actual test results on a prototype antenna revealed relative deflections of 0.300 inch at resonance. Author

N65-20321 Martin Co., Baltimore, Md.
EXPERIMENTAL RESULTS OF THE APPLICATION OF SAMPLING TECHNIQUES TO VARIOUS TYPES OF FLIGHT DATA
John Sudey, Jr. *In* NRL Shock and Vibration Bull. Feb. 1965 p 107–114 refs (See N65-20313 10-14)

The encoding of analog flight data to PCM consists of converting continuous data into discrete numbers. The procedure involves filtering followed by sampling, i.e., defining the points at which the data are observed. The number of samples must be sufficient to describe properly the highest frequency in the signal reaching the encoder. Yet, excessively high sampling rates must be avoided from a cost viewpoint. Hence, sampling should be held to the lowest rate which will avoid aliasing errors. Analytical studies have been made of this problem. This paper compares these analyses to the results of an empirical study of the effect of sampling rate on the accuracy of data acquisition by the use of PCM encoder and decoder. Random and sinusoidal signals are considered. Author

N65-20330 Joint Publications Research Service, Washington, D. C.
THRESHOLD VALUES OF THE SIGNAL-TO-NOISE RATIO IN AUTOCORRELATED RECEPTION OF FLUCTUATING SIGNALS
Yu. S. Lezin *In its* Izv. VUZov: Radio Eng., Vol. 7, No. 5, 1964 5 Mar. 1965 p 42–51 refs (See N65-20326 10-10) CFSTI: $5.00

The correlation is calculated for the additive mixing of any arbitrary correlated fluctuating signal and noise. The law of probability distribution is derived for the voltage which results from mixing the fluctuating signal with noise at the output of the autocorrelating device. The probabilities of false alarm and correct detection are derived for autocorrelated reception of fluctuating signals. The threshold values of the signal-to-noise ratio in autocorrelated reception are calculated for the case of noncorrelated noises and are compared with the case of square-law detection. Author

N65-20332 Joint Publications Research Service, Washington, D. C.
EXCITATION OF SURFACE WAVES BY CONTINUOUS NON-PROTRUDING SOURCES
M. S. Bobrovnikov, V. L. Mironov, and V. P. Smirnov *In its* Izv. VUZov: Radio Eng., Vol. 7, No. 5, 1964 5 Mar. 1965 p 68–78 refs (See N65-20376 10-10) CFSTI: $5.00

Two forms of continuous nonprotruding sources of surface waves in an impedance plane are analyzed; with one, it is possible to produce symmetrical excitation; with the other, to produce directional excitation of surface waves very effectively. Author

N65-20333 Joint Publications Research Service, Washington, D. C.
INCIDENCE OF PLANE WAVES ON THE BOUNDARY SURFACE BETWEEN VACUUM AND A NON-HOMOGENEOUS ABSORBING MEDIUM
Ye. A. Filatova *In its* Izv. VUZov: Radio Eng., Vol. 7, No. 5, 1964 5 Mar. 1965 p 79–86 refs (See N65-20326 10-10) CFSTI: $5.00

Incidence of plane waves on the boundary surface between vacuum and a nonhomogeneous absorbing medium is analyzed for the case where polarization is in the plane normal to the plane of incidence. Author

N65-20334 Joint Publications Research Service, Washington, D. C.
DETECTION AND FREQUENCY MEASUREMENT OF A WEAK SIGNAL SUBMERGED IN NOISE BY THE METHOD OF COUNTING ZEROS
Yu. S. Zakharov and V. P. Tikhomirov *In its* Izv. VUZov: Radio Eng., Vol. 7, No. 5, 1964 5 Mar. 1965 p 87–98 refs (See N65-20326 10-10) CFSTI: $5.00

A method of weak signal detection within a wideband noise and of measuring its frequency is analyzed. This method is based on the count of zeros; certain relations are derived on the basis of which its feasibility can be approximately evaluated. Some experimental results are shown and recommendations are made for the design of such apparatus. Author

N65-20339 Joint Publications Research Service, Washington, D. C.
ON THE NON-LINEARITY OF FREQUENCY VARIATION IN FREQUENCY-MODULATED RADAR
K. B. Krukovskiy-Sinevich and N. M. Malyarevskiy *In its* Izv. VUZov: Radio Eng., Vol. 7, No. 5, 1964 5 Mar. 1965 p 129–132 refs (See N65-20326 10-10) CFSTI: $5.00

The effect of nonlinearity in the detection of a signal against the background of fluctuating noise in a frequency-modulated radar is determined. The signal-to-noise ratio is discussed and the relative nonlinearity evaluated. E.E.B.

N65-20340 Joint Publications Research Service, Washington, D. C.

TO THE PROBLEM OF ANTI-NOISE CHARACTERISTICS OF A RECEIVER WHICH GIVES THE TOTAL READING OF AN AUTOCORRELATED FUNCTION

Yu. A. Dolgopolov *In its* Izv. VUZov: Radio Eng., Vol. 7, No. 5, 1964 5 Mar. 1964 p 133–137 refs (See N65-20326 10-10) CFSTI: $5.00

Formulas are developed for the determination of the necessary number of channels and the required width of the bandpass in the receiver in order to assure that the prescribed gain will be attained in the signal-to-noise ratio in comparison with the filter–square law detector–integrator system. In the case of an unlimited passband with a finite number of receiver channels the gain is finite; its magnitude represents the capability limit of such a receiver in which the passband has been widened. E.E.B.

N65-20392 Library of Congress, Washington, D. C. Aerospace Technology Div.

STUDIES OF DIFFRACTION OF ULTRASHORT WAVES BY MOUNTAINS PEAKS

In its Foreign Sci. Bull., Vol. I, No. 1, Jan. 1965 [1965] p 4–7 refs (See N65-20390 10-34)

Studies of microwave transmission in the mountains of the Kirghiz S.S.R. have shown that adding a simple passive grid of suitable geometry to a mountain peak in the transmission path results in an essentially Fresnel diffraction of the field. This diffraction substantially lowers the attenuation caused by the peak, and avoids the more difficult and expensive system of active repeater stations on mountain tops. Test techniques and grid geometries are discussed, and a summary is given of comparative attenuations measured with and without a grid in several microwave links in the Kirghiz region. Author

N65-20407*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

UNIFIED S-BAND TELECOMMUNICATIONS TECHNIQUES FOR APOLLO. VOLUME I: FUNCTIONAL DESCRIPTION

John H. Painter and George Hondros Washington, NASA, Mar. 1965 86 p refs

(NASA-TN-D-2208) CFSTI: HC $3.00/MF $0.75

This document is a functional description of the intended configuration and operation of the Apollo Unified S-band Telecommunications and Tracking System. In particular, this description applies to the link between the command-service module and the ground tracking station. The lunar excursion module-to-ground link is similar, and an equivalent description applies. The document begins with a short resume of the system's developmental history. Then the basic spacecraft and ground system concept are simply explained. Following are detailed descriptions of the communications signals, modulation techniques, and subsystem configurations. The document concludes with explanations of system operational techniques. Author

N65-20418*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

TRACKING AND DATA HANDLING FOR THE PIONEER III AND PIONEER IV FIRINGS

Manfred Eimer and Robertson Stevens 14 Aug. 1959 37 p (Contract NASw-6)

(NASA-CR-57647; JPL-EP-701) CFSTI: HC $2.00/MF $0.50

Major requirements of the tracking and data-handling network used for Pioneers III and IV were (1) to provide continuous reception of telemetering data to several tens of thousands of kilometers in order to receive cosmic-ray data from the outer radiation bands, (2) to communicate to distances beyond the moon, and (3) to make the precision angular measurements required for accurate determination of the flight paths of the probes. The cosmic-ray data measured by the vehicles were encoded to maximize the information transmission capability for the limited bandwidth available with the communications system. The tracking network consisted of doppler and angle tracking stations in Florida, Puerto Rico, and California which had the capability of phase-coherent detection of the transmitted carrier signal, automatically encoding the time-tagged tracking data into standard teletype format, and transmitting the information to a digital computer. Author

N65-20445# Harry Diamond Labs., Washington, D. C.

RELATIONSHIP BETWEEN TIME-SPECTRAL DENSITIES OF TEMPERATURE AND LOGARITHMIC AMPLITUDE FLUCTUATIONS

Walter J. Brinks 15 Oct. 1964 12 p refs

(HDL-TR-1258; AD-455095)

A theoretical study has been made to determine the relationship between time-spectral densities of temperature and intensity fluctuations, measured at a point in the atmosphere. This relationship is based largely on Tatarski's theory of the effects of atmospheric turbulence on electromagnetic and acoustical propagation. The results of this study indicate that there is no direct relationship between these two spectra. The shape of each spectrum is determined in advance by the general physics of turbulence and electromagnetic-wave propagation. The time variations in temperature and radiation amplitude have no mutual significance nor direct functional relationship. The temperature spectrum, however, depends upon the total wind speed, whereas the logarithmic-amplitude spectrum depends upon the wind speed normal to the propagation path. Author

N65-20447# Naval Ordnance Lab., Corona, Calif. Research Dept.

MICROWAVE RADIOMETRIC CONTRASTS. MEASUREMENTS OF VARIOUS MATERIALS AGAINST A TERRAIN BACKGROUND, PART I

M. C. Hoover, Jr., R. L. Huckins, R. P. Moore, C. A. Hawthorne, and J. S. Mendiola 15 Dec. 1964 40 p refs

(NAVWEPS-8223; AD-455551)

Measurements described in this report were performed to substantiate data taken from March to June 1964. Some of the data obtained during the March to June period were believed inconclusive because of radar interference and insufficient information. These new measurements were made on (1) a single aluminum target observed for an extended period of time, (2) tilted aluminum targets, and (3) aluminum targets covered with various materials. Data were obtained from a radiometer atop a 100-ft tower at NOLC. Author

N65-20460# Library of Congress, Washington, D. C. Aerospace Technology Div.

ELECTROMAGNETIC LIGHT WAVES IN COMMUNICATIONS ENGINEERING Translations of Soviet-Bloc Scientific and Technical Literature

15 Jan. 1965 19 p refs Transl. into ENGLISH from Slaboproudy Obzor (Prague), v. 25, no. 6, 1964 p 313–318

(ATD-T-65-2; AD-610130)

In this article, basic questions related to the use of light waves for transmission of information are treated. The generation of light waves, their modulation, and their detection

are covered. Main emphasis is on the transmission of information in the atmosphere under normal meteorological conditions and by means of light guides. The possibility of using light waves for information transmission in the near future is critically evaluated. Author

N65-20527# Polytechnic Inst. of Brookly, N. Y. Microwave Research Inst.
ELECTROMAGNETIC WAVE PROPAGATION ALONG A SINUSOIDALLY STRATIFIED DIELECTRIC SLAB
H. C. Wang Dec. 1964 193 p refs
(Contract AF 19(628)-4324)
(PIBMRI-1227-64; AFCRL-65-85; AD-612635)

The guiding and scattering of electromagnetic waves in a periodically stratified dielectric slab located in free space are investigated. The medium of the slab is stratified by varying the permittivity as $\epsilon(z) = \epsilon_r [1 - M \cos (2\pi/d\ z)]$ where the yz plane coincides with the air-dielectric interface. The problem is solved by representing the fields in both the air and the dielectric regions in terms of modes with propagation normal to the slab. For a field polarized along the y direction, these modes are Bloch exponentials in the air region and Mathieu functions in the dielectric. A discrete spectrum of bound (surface) waves and leaky (complex) waves may be supported by such a configuration. The scattering properties indicate rapid fluctuations in certain frequency ranges for the space harmonics. The dispersion curves of the stratified (modulated) slab exhibit the familiar stop-band behavior due to periodicity. However, additional stop bands were found for certain ranges of the parameters involved; these stop bands were not recognized previously and they are explainable in terms of the coupling of higher modes of the uniform (unmodulated) slab. Author

N65-20533# Raytheon Co., Wayland, Mass. Advanced Development Lab.
NEWBURYPORT ANTENNA: TEST RESULTS Final Report
John E. Walsh and Neil F. Lacey 1 Dec. 1964 31 p
(Contract AF 19(628)-496)
(AFCRL-64-987; AD-612789)

This report contains results of some flight tests performed on a 3500-foot, multiplicative, scanning array operating at 30 to 50 Mc/sec and providing multiple receiving beams one-half degree wide in azimuth. Calibration and testing procedures are described, with particular reference to patterns taken by focusing in the near field. Test results were encouraging but not conclusive, and emphasize the existence of major difficulties in the assessment of characteristics of directive antennas at frequencies below uhf. Author

N65-20557# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
SCIM—A METER FOR MEASURING THE PERFORMANCE OF SPEECH COMMUNICATION SYSTEMS Interim Report
Karl D. Kryter and Jay H. Ball Bedford, Mass., AFSC, Electron. Systems Div., Oct. 1964 44 p refs
(Contract AF 19(628)-2463)
(BBN-1166; ESD-TDR-64-674; AD-611082)

The subject of the present paper is an electronic device called SCIM (Speech Communication Index Meter) that is designed primarily in terms of the Articulation Index (AI) theory; however, SCIM accommodates additional factors affecting speech that are not involved in the original procedures for calculating AI. The SCIM signal generator generates a 3-second signal burst, which is fed to the electrical input of the system under test; within 12 seconds the SCIM analyzer, located at the receiving station, calculates and displays an index, ranging from 0.00 to 0.99, which reflects the ability of that system to transmit intelligible speech. Author

N65-20615*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PRELIMINARY REPORT ON PARABOLOIDAL REFLECTOR ANTENNA WIND TUNNEL TESTS
Norman L. Fox and Bain Dayman, Jr. 28 Feb. 1962 47 p refs
(NASA-CR-57572; JPL-IM-CP-3) CFSTI: HC $2.00/MF $0.50

This paper presents some of the more significant results of a wind-tunnel test on small models of paraboloidal reflector antennas. As contrasted to tests of a single final design configuration, the effects on wind loads of such parameters as focal distance to diameter ratio, surface porosity, spoilers, a simulated support structure, pivot center position, etc., were examined on relatively simple models. The Reynolds number of the test data is sufficiently high to make the results applicable to full-scale installations. The results of this test show some of the gains to be made by designing such an installation from wind loads, as well as structural and rf efficiency aspects. A bibliography is included. Author

N65-20616*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LOAD DISTRIBUTIONS ON THE SURFACE OF PARABOLOIDAL REFLECTOR ANTENNAS
Norman L. Fox Jul. 1962 58 p ref
(NASA-CR-57559; JPL-IM-CP-4) CFSTI: HC $3.00/MF $0.75

Pressure distributions over the surfaces of a thin paraboloid of revolution adjacent to a ground plane were measured. Data are presented for solid, rim-porous, and uniformly porous paraboloidal surfaces at several angular attitudes relative to the ground plane. Integrations of these pressure data over the areas are compared with directly measured force and moment data. A strong localized edge-loading was found for the solid surface configuration when nearly edge-on to the wind; surface porosity relieved this condition. This material comprises a more detailed presentation of the results from a wind-loads test on paraboloidal reflector antenna models. Author

N65-20617*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COMMUNICATIONS TO AND FROM LUNAR AND PLANETARY SPACECRAFT
Eberhardt Rechtin [1961] 76 p refs Preliminary rept. to the Earth-Space Sub-Group 1, Study Group IV, C.C.I.R. Includes JPL-TM-33-27 (N63-20963)
(NASA-CR-57589; JPL-TM-33-27) CFSTI: HC $3.00/MF $0.75

Investigations of the previously established desirable frequency range of 1000 to 10000 Mc/sec. for deep space communcations using maser receivers and directional spacecraft antennas narrowed the band to the 2290 to 2300 Mc/s as the most desirable allocation. The use of high-power ground transmitters and other ground services in the vicinity of the deep space station must be controlled to prevent interference. The 2110 to 2120 Mc/s band is recommended for earth to space tracking and communciations within 100 to 300 miles of the deep space tracking stations. The 8400 to 8500 Mc/s band can be used for future wideband communications from the moon. The 1427 to 1429 Mc/s band can be utilized for service from the moon if the 2290 to 2300 Mc/s band becomes saturated. There is no need to allocate frequencies below 1000 Mc/s and above 10000 Mc/s under the present plans. G.G.

N65-20693# Technical Research Group, Inc., Melville, N. Y.
RANGE AND ANGLE ERRORS FOR TIME-DEPENDENT SIGNALS WITH A RECTANGULAR FREQUENCY SPECTRUM
Visvaldis Mangulis Nov. 1964 22 p refs
(Contract NObsr-93023)
(TRG-023-TN-64-1; AD-454737)

The signal amplitude is assumed to be of the form $\sin \sigma t / \sigma t$, where t is the time and 2σ the bandwidth. The signal is incident at an angle on a line receiver; the time required to traverse the receiver can be greater or less than the effective pulse length of the signal. It is shown that the error in the time of arrival of the peak signal (which is proportional to an error in the range to a target) is inversely proportional to the bandwidth in the limit of very small or very large bandwidths, and it has some additional dependence on σ between these extreme limits. The error in the angle of the signal arrival is inversely proportional to the center frequency for small bandwidths, and it is inversely proportional to the bandwidth for large bandwidths. Author

N65-20717# Battelle Inst., Frankfurt am Main (West Germany).
MODEL NBGS NARROW-BAND GAIN-STABLE RECEIVER OPERATING AND SERVICING MANUAL
Joseph Eitzenberger, Karl-Friedrick Kammerlander, and Klaus-Peter Vetter Feb. 1965 188 p
(Contract DA-91-591-EUC-1873)

A narrowband, gain-stable, high frequency radio receiver with unusally high immunity to intermodulation and cross-modulation disturbances is described. The third-order intermodulation product in the receiver remains 70 dB below the level of the interfering signal if the interfering signals remain more than 1 and 2 kc/sec from the desired signal. An interfering signal separated from the desired signal by more than 5 kc/sec and not more than 90 dB larger than the desired signal will produce no more than 5% cross modulation. This receiver was developed to observe fluctuations in signal strength and Doppler frequency shifts in sky-wave propagated high frequency radio signals. Author

N65-20757*# Goodyear Aerospace Corp., Akron, Ohio.
HIGH-GAIN SPACECRAFT ANTENNA DESIGN AND DEVELOPMENT Final Report
J. W. Haylett Apr. 1964 96 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950467)
(NASA-CR-57742; GER-11156) CFSTI: HC $3.00/MF $0.75

A 9-foot advanced development model of an expandable, directive, high-gain spacecraft antenna was fabricated. The model demonstrated the feasibility of the design approach resulting from the design study. This report documents the program of preliminary design and analysis, model design and fabrication, and model testing; outlines antenna ground deployment procedures; and presents conclusions and recommendations. Author

N65-20856# Weapons Research Establishment (Australia).
TABLES OF WEIGHTING COEFFICIENTS OF LINEAR DISCRETE FILTERS FOR USE IN THE ESTIMATION OF POSITION, VELOCITY AND ACCELERATION FROM FBS 16 RADAR DATA
W. W. Barnes Nov. 1964 216 p refs
(WRE-TN-SAD-140)

A method is described for computing the weighting coefficients of linear discrete filters optimized for polynomial signals with additive serially correlated noise. Values of the coefficients are presented for various polynomial signals, and for a range of values of timespreads and sampling intervals. The noise output for each filter is given, and, in the case of the first derivative, is compared with that from a white noise filter with an identical correlated noise input. Author

N65-20872# Air Weather Service, Scott AFB, Ill.
ESTIMATING METEOROLOGICAL EFFECTS ON RADAR PROPAGATION, VOLUME I
W. B. Moreland Jan. 1965 207 p refs
(TR-183, Vol. I; AD-459466)

Observed operational anomalies in radio–radar equipment performance and the important physical phenomena producing these anomalies are discussed. The most important contributing phenomenon in the explanation or prediction of anomalous performance is atmospheric refraction. Methods are presented for describing the refractive properties of an atmosphere in terms of specific refractivity conditions. The mechanisms of propagation from a transmitter to a point in space and several meteorological effects on these mechanisms are considered. Graphical methods are shown for computing bending, elevation angle, range, and height errors caused by atmospheric refraction. Refractivity climatology is discussed in connection with synoptic applications. General procedures for translating this information into useful propagation criteria are given, and operational procedures for meteorological support of radar missions are suggested. E.P.V.

N65-20922# Michigan Univ., Ann Arbor. Radar Lab.
CLUTTER CANCELLATION IN SQUINTED-BEAM AMTI
Charles B. Sharpe Mar 1965 21 p refs
(Contract DA-28-043-AMC-00013(E); Proj. Michigan)
(Rept.-6400-17-R; AD-458782)

The analysis of squinted-beam AMTI systems is considered, using as a performance criterion the clutter cancellation ratio. A particular system incorporating a dual-feed, uniformly illuminated line antenna is evaluated and shown to be effective in substantially reducing ground clutter. The design of this system is specified in terms of two convenient parameters, the squint angle, and a gain factor. Author

N65-20963# Japan. Ministry of Posts and Telecommunications, Tokyo.
RADIO RESEARCH LABORATORIES
1963 24 p

The location of the laboratories and the services provided by the agency are described. A brief history of ionospheric observations in Japan, studies of the ionosphere, low-density plasma research, ionospheric propagation, space communications, tropospheric scatter, radio meteorology, millimeter waves, communications system, information processing, solid state maser, frequency standards, radio forecasting, broadcasting, and publications and periodicals are presented with illustrations. Also, the World Data Center for the Ionosphere is discussed. E.E.B.

N65-20971*# Maryland Univ., College Park. Dept. of Physics and Astronomy
ON THE DEPOLARIZATION OF DISCRETE RADIO SOURCES BY FARADAY DISPERSION Technical Report No. 440
B. J. Burn Mar. 1965 51 p refs Submitted for Publication
(Grant NsG-5860)
(NASA-CR-57777) CFSTI: HC $3.00/MF $0.50

The implications of the recent polarization measurements for the structures of discrete radio sources and the source-observer media are studied. Simple models of wavelength-dependent deplorizing mechanisms are investigated, most

are found incompatible with the observations of Gardner and Whiteoak. The models of internal Faraday dispersion predict a lower polarization at 30-cm than is observed. It is suggested that the depolarization of the Crab nebula is produced by Faraday rotation in the filamentary shell that surrounds the nebula. Such filaments could also exist in the outer regions of extragalactic sources. A complex number representation is used for the state of linear polarization, and a Faraday dispersion function is defined to describe the distribution of polarized radiation with respect to Faraday depth. Upper limits are given for the possible densities of internal ionized gases in the sources for which we have polarization measurements. Author

N65-20976# Pan American World Airways, Inc., Fort Huachuca, Ariz. Guided Missile Range Div.
U.S. ARMY RFCP SPECTRUM SIGNATURE PROGRAM 4th Quarterly Progress Report, 1 Aug.–31 Oct. 1964
[1964] 41 p
(Contract DA-02-086-AMC-0032(R))
(Rept.-4; AD-454901)

Laboratory modifications were completed, including screen room cooling and glass partitions, and test equipment items were procured. Summaries are included on the status of the various assignments, and their implementation. Author

N65-21006*# Consultants and Designers, Inc., Arlington, Va.
ON THE PROPAGATION OF POWERFUL RADIOWAVES IN THE IONOSPHERE [K VOPROSU O RASPROSTRANENII SIL'NYKH RADIOVOLN V IONOSFERE]
E. I. Ginzburg 8 Apr. 1965 12 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Radiotekhn. (Kiev), v. 7, no. 6, 1964 p 1041–1048
(Contract NAS5-3760)
(NASA-TT-F-9664; ST-RWP-AI-10315) CFSTI: HC $1.00/MF $0.50

The propagation of powerful radiowaves in the lower ionosphere is considered. Formulas are obtained for the amplitude of wave field intensity, as it penetrates into the feebly ionized plasma. The question of autoreaction of powerful radiowaves in the ionosphere was worked out on the basis of joint consideration of the joint solution of nonlinear wave equation in the geometric optics approximation and of elementary theory expressions for the permittivity ϵ and conductivity σ of the plasma. The autoreaction factor leads as a rule to the necessity of numerical integration. Author

N65-21040# Harvard Univ., Cambridge, Mass. Cruft Lab.
SCATTERING OF ELECTROMAGNETIC WAVES BY A HELICAL SHEATH CYLINDER Scientific Report No. 7 (Series 3)
Chin-Lin Chen 4 Nov. 1964 44p refs
(Contract AF 19(628)-2406)
(AFCRL-65-6; AD-612631)

The problem of the scattering from a helical was investigated. A harmonic series solution is obtained for the case with TE-mode incidence. Due to the anisotropic nature of the boundary, both TE mode and TM mode are present in the scattered field and the transmitted field. The expressions for the total scattering cross section, the back scattering cross section and the current density distribution are also obtained. Some numerical results are presented for a helical structure with a radius that is small or moderate in comparison with the wavelength. A strange behavior as the pitch angle approaches $\pi/2$ is found. The nature of this strange behavior is discussed in detail. Author

N65-21044# Navy Electronics Lab., San Diego, Calif.
RECEIVING ANTENNA COMPLEX FOR 2 TO 8 MC/S Research and Development Report, Jul. 1962–Dec. 1963
W. E. Gustafson, W. M. Chase, and J. L. Lievens 15 Jan. 1965 22 p refs
(NEL-1259; AD-458419)

A full-scale tower and four rf tuners and whips were built and tested. The feasibility of simultaneous operation of 12 tuned whips on a single 25-foot grounded tower was demonstrated. Tower efficiency with 5% frequency separation between tuners, is within ±3 dB of the design goal. Controlled efficiency of the system results in greater isolation from transmitting antennas, with corresponding increased receiver protection, and greater rejection of interfering signals. Author

N65-21050# Harvard Univ., Cambridge, Mass. Cruft Lab.
INFINITE SHEATH HELICAL ANTENNA Scientific Report No. 5 (Series 3)
Chin-Lin Chen 20 Oct. 1964 26 p refs
(Contract AF 19(628)-2406)
AFCRL-65-5; AD-612643)

The problem of an infinite sheath helical antenna driven by a ring delta generator is considered. The Fourier transform technique is used to solve this problem. It is found that if the radius of the helix is not too large, $\beta b < 2.4048$, where $\beta = 2\pi/\lambda$ and b is the radius of the helix, the current density far away from the driving point can be decomposed into two terms. The first term is constant in magnitude and its phase velocity is less than the speed of light. It is a slow wave term. The second term dies out as $1/z^2$, where z is the axial distance from the driving point, and has a constant phase velocity of β. This is the radiation term. Near to the driving point, the logarithmic singularity exists just as in the case of an infinite linear, perfectly conducting dipole antenna. Author

N65-21099# Montana State Univ., Missoula. Communication Research Lab.
EXPERIMENTAL TECHNIQUE FOR THE STUDY OF HUMAN COMMUNICATION
Forrest L. Brissey Sep. 1964 76 p refs
(Grant AF-AFOSR-62-214)
(AFOSR-64-2409; AD-609946)

A visual display apparatus, utilizing the placement of pegs into selected holes designating the display in question, was used to transmit messages from one person to another to evaluate the detection and assessment of those conditions which significantly influence the receiver's behavior. The results of empirical studies of one or more parameters assumed to influence the effectiveness of communication were applied in the process of serial reproduction of information through chains. It was concluded: (1) When a receiver is free to terminate the criterion task, display completion decreases through the first four groups, while discrimination drops initially and then remains constant through the last four groups. (2) When a receiver is required to complete the task, discrimination declines to a level of best guess for the fifth group. (3) Subjects maximize completion at the expense of discrimination when the message adequacy is low. G.G.

N65-21105# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
USE OF RECYCLING DEVICES FOR FREQUENCY-MODULATION-PULSE COMPRESSION
V. V. Lebedev 14 Dec. 1964 13 p refs Transl. into ENGLISH from Radiotekhn. (Moscow), v. 18, no. 11, 1963 p 62–70
(FTD-TT-64-524/1+2; AD-610355)

The possibility of using multiple recyclings of the FM signal in a retardation line with feedback (recycling device) for the purpose of noise separation is discussed. The general process of FM signal recycling is considered, as well as passing the FM signal through a recycling device with displacing heterodyne. Frequency demodulation of the input signal and formulation of the required pulse characteristics of the filter are also discussed, in addition to compression of the FM pulse. The signal-to-noise ratio improvement in the recycling device is compared with the improvement in retardation lines with dispersion. E.P.V.

N65-21109# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DISTRIBUTION OF OVERSHOOT LENGTH FOR THE ENVELOPE OF THE SUM OF A SINUSOIDAL SIGNAL WITH NORMAL NOISE ABOVE THE THRESHOLD LEVEL
B. R. Levin and Ya. A. Fomin 22 Dec. 1964 9 p refs Transl. into ENGLISH from Radiotekhn. (Moscow), no. 1, 1964 p 13–17
(FTD-TT-64-1051/1+2+4; AD-610353)

The approximation method considered elsewhere makes it possible to present in analytic form the sought probability density and integral function of overshoot length distribution. This method is based on the fact that in the range of small overshoot lengths the distribution function is described with sufficient accuracy by its first approximation, and in the range of large lengths it decreases exponentially. Moreover, use is made of the constancy of unit area under the distribution curve and of the constancy of the first moment of the probability density of a known value of average overshoot length. This method was used to approximate the function of overshoot length distribution for the envelope of the sum of signal and noise below the threshold level. Author

N65-21129# Institute for Defense Analyses, Washington, D. C. Research and Engineering Support Div.
THE DOPPLER RADAR SPECTRUM OF AN ACCELERATING TARGET
J. Menkes Dec. 1964 16 p ref
(Contract ARPA SD-50; Proj. Defender)
(IDA/HQ-64-3076; P-156; AD-455322)

The Doppler spectrum of a monochromatic source moving with a constant acceleration is examined. The behavior of the spectrum as a function of observation time and magnitude of the acceleration is deduced in closed form. It is found that the width of the spectrum is proportional to the square root of the number of quarter wavelengths that the source travels due to its acceleration. Results are presented in graphical form. Author

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N65-20146 Joint Publications Research Service, Washington, D. C.
ON LOCATION OF COMMANDS FOLLOWING A COMMAND WITH RANDOM EXECUTION TIME WITH OPTIMAL PROGRAMMING
A. I. Serebryanyy *In its* Transl. from Zh. Vychislitel'noy Mat. i Mat. Fiz. (J. of Computer Math. and Mathematical Phys.), Vol. 4, No. 6, Nov.–Dec., 1964 24 Mar. 1965 p 41–46 *ref* (See N65-20143 10-19) CFSTI: $3.00

The method for reducing the time required for execution of programs is discussed. A solution is proposed for the determination of an optimal distance and interval at which a subsequent instruction must be located in optimal programing. If the time required for execution of an instruction is fixed or depends on some parameter whose value is known, a location is determined for the next instruction so that it begins to be executed immediately after termination of the previous instruction. E.E.B.

N65-20261 Joint Publications Research Service, Washington, D. C.
MATRIX METHOD OF SPEEDING UP DIGITAL COMPUTER ARITHMETIC OPERATIONS
Yu. A. Popov, L. N. Sumarokov, and Ya. A. Khetagurov *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 6, 1964 24 Mar. 1965 p 64–71 refs (See N65-20252 10-09) CFSTI: $5.00

Analyzed in this article are two methods (with their apparatus) of second-order acceleration of multiplication, executed on digital computers. In one of these methods the equipment may be used for effectively carrying out addition operations. There are three independent types of methods for increasing the speed of arithmetic operations carried out by digital computers: (1) instrument, or matrix, methods—due to an increase in equipment proportional to the degree of the amount of columns of numbers; (2) logical methods—due to perfecting the systems of controlling the operations; (3) methods based on increasing the high speed of the elements of the unit. In practice these methods are used in combination with one another to achieve the best results. On the other hand, it is necessary to perfect methods for increasing the arithmetic operations within each of these groups. Author

N65-20308# Stanford Research Inst., Menlo Park, Calif.
RESEARCH ON COMPUTER NEURISTOR DEVICES Final Summary Report, 1 Jun. 1960–1 Sep. 1964
Milton W. Green 8 Jan. 1965 13 p refs
(Contract Nonr-3212(00))
(AD-610095)

The historical development of neuristor research activities, including the areas in which substantial progress was made, and the difficulties encountered in practical device realization are summarized. Logic studies were the subject of a very thorough treatment. As a result there now exists a comprehensive logical design basis for general neuristor systems. Basic problems involved in neuristor development, and the conflicting requirements for semiconductor materials are discussed. Also, solid-state lines that avoid the use of junctions were also studied. It was noted that although experimental semiconductor neuristors were nondistributed and relatively impractical, they did furnish the only demonstration of an all-electric neuristor device with logical capability. It was concluded that it will be an extremely difficult technical feat to achieve neuristor systems that are in any sense competitive with present logic devices. E.E.B.

N65-20328 Joint Publications Research Service, Washington, D. C.
ON THE CONSTRUCTION OF THE "MAN-MACHINE" MEDIATOR LINK IN A SYSTEM FOR GROUP PROGRAMMED TEACHING WITH AN ELECTRONIC DIGITAL COMPUTER

V. T. Kulik and V. P. Shirochin *In its* Izv. VUZov: Radio Eng., Vol. 7, No. 5, 1964 5 Mar. 1965 p 17-30 refs (See N65-20326 10-10) CFSTI: $5.00

Analyzed is a system which operates on information input-output in an electronic digital computing machine with a group of operators learning according to programed texts. The principal schematic diagrams of the operator's desk and block diagrams of the multichannel mediator link with a Minsk-type EDCM are shown. Author

N65-20411# Sylvania Electric Products, Inc., Waltham, Mass. Applied Research Lab.
DOCUMENT FORMAT RECOGNITION Final Report
Steven B. Gray Griffiss AFB, N.Y. RADC, Jan. 1965 465 p refs
(Contract AF 30(602)-3273)
(F-3060-1; RADC-TDR-64-463; AD-611632)

This study is primarily concerned with methods for analyzing the format of pages from technical journals, and means for automatically processing the textual and graphic material on these pages for input to a computer which is to perform textual data processing functions. The overall process is considered to be a format recognition and analysis program operating on a computer-controlled character recognition device. This study resulted in general design techniques for format recognition and analysis programs applicable to any document which occurs with text and graphics intermixed. Also considered in detail is a design for the universal print reader, which involves techniques tried and proven in present print reader devices. An augmented version of the universal print reader, which enables fully automatic page composition of translated versions of journal pages, is briefly described. Author

N65-20548# Stanford Univ., Calif. Dept. of Statistics
STATISTICAL CONTROL OF A BERNOULLI PROCESS
Howard M. Taylor 4 Feb. 1965 45 p refs
(Contract Nonr-225(53))
(TR-79; AD-611545)

The optimal statistical control of a simple production process which has only two underlying states, good and bad, is studied. The produced items are classified as good or defective, a cost being associated with each defective item produced. A cost is also charged for repairing the process, which has the effect of returning the process to the good state. Other than immediately after repair, the process state is assumed unknown. One seeks a statistical control rule which, based on the quality history of produced items, tells when to repair the machine. A feasible means of computing the control rule which minimizes the average cost per unit time is given. The nature of the solution is such that once tables of operating characteristics have been prepared, the solutions to a wide variety of problems may be had through slight additional hand calculations. The optimal rule is shown to be relatively insensitive to errors in estimating the model parameters. A means of checking, over a long period of time, whether or not estimates are correct has also been suggested. Author

N65-20648# Aeroplane and Armament Experimental Establishment, Bascombe Down (England). Weapon Systems Div.
A DIGITAL MAGNETIC TAPE TO PUNCHED PAPER TAPE TRANSLATION SYSTEM
M. Lake London, Min. of Aviation [1965] 18 p
(AAEE/TECH/287/WEA)

A ground-based system is described which was designed and developed to translate 16-track magnetic tape data onto 8-hole-punched paper tape. Editing facilities are included to enable only selected data to be translated. Author

N65-20711# David Taylor Model Basin, Washington, D. C. Applied Mathematics Lab.
A TECHNIQUE FOR UTILIZING THE IBM OR THE RCA RANDOM-ACCESS MASS-MEMORY DEVICES TO STORE THE DATA BASE OF A COMMAND AND CONTROL INFORMATION PROCESSING SYSTEM
Paul E. Friedenberg and Thomas S. Walton Nov. 1964 14 p refs
(DTMB-1917; AD-610211)

Two different mass memories are studied for their suitability to store the data base in a command and control information-processing system. The IBM unit employs metal disk packs whereas the RCA unit uses magazines of plastic cards for the recording medium. However, analogies in their logical capabilities make it possible to use identical methods of file organization. It is shown that the equipment can be effectively utilized to process formated files on a random-access basis. Compact indexes are generated so that items can be quickly located either by name or by content. The times required for updating and searching such files are analyzed, and the advantages to be gained over conventional techniques are indicated. Author

N65-20728# RAND Corp., Santa Monica, Calif.
AN AUTOMATED SYSTEM FOR HANDLING DEFENSE CONTRACTOR LONG-RANGE FINANCIAL PROGRAMMING INFORMATION
F. W. Finnegan and F. S. Pardee Nov. 1964 352 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4295-PR; AD-460318)

A computer management system, capable of sorting, summarizing, and maintaining a record of changes, was developed to handle long range financial programing information on the development and procurement of major weapon systems. The programs are written for the IBM 1401 computer, but are also usable on IBM 1410 equipment. Flow charts, input sheets, and print layouts, as well as the programs themselves, are included for all major computer routines and provide a framework upon which additional aspects of overall financial planning and control systems can be built. G.G.

N65-20842# European Atomic Energy Community, Brussels (Belgium). Geel Establishment
STUDIES AND DEVELOPMENT OF BUFFER STORAGE SYSTEMS FOR NUCLEAR EXPERIMENTS
W. Stüber Nov. 1964 49 p refs
(EUR-2160.e) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 40 Belg. Fr.

Some introductory remarks on the use of buffer stores in data handling systems for nuclear measurements are made. Considerations and calculations on the tolerable dead time and the necessary size of buffer stores in relation to time-of-flight experiment conditions are presented. Rules and curves for the spectrum distortions caused by buffer stores are given. Two buffer stores are described briefly. The two stores, a 10-word ferrite-core store with a cycle time of 2 μsec and a 3-word tunnel-diode store having a cycle time of 0.1 μsec can be combined. Loss curves measured with the ferrite-core store are discussed. Author

N65-20844# European Atomic Energy Community, Brussels (Belgium).
THESIS 2: A FORTRAN CODE FOR THE CALCULATION OF THERMAL SPECTRA AND CROSS-SECTIONS

C. Mongini-Tamagnini and C. Ponti Dec. 1964 49 p refs (EUR-2187.e) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 60 Belg. Fr.

The code THESIS 2 numerically solves the integral balance equation for thermal neutrons in homogeneous media and provides the corresponding spectrum and average multigroup thermal cross sections. The scattering kernel can be computed by the code itself, in the framework of the free gas model, or can be given in input. Heterogeneous media are also treated, by introducing the energy-dependent self-shielding factors of each isotope. An external (positive or negative) neutron source can be considered. Author

N65-20849# Iowa State Univ. of Science and Technology, Ames. Ames Lab.
WRITING TOPOLOGICAL PROGRAMS FOR I.S.U. GUTS
William J. Kernan, William J. Higby, and Iva H. Boessenroth Sep. 1964 49 p
(Contract W-7405-ENG-82)
(IS-989) CFSTI: $2.00

An analysis of bubble chamber data through the use of a computer program, GUTS, is made. This system is designed in a general manner. A wide variety of interactions in bubble chambers may be studied by writing control programs describing the interaction. The techniques employed and the method of writing these programs will be presented. Author

N65-20867# Autonetics, Anaheim, Calif.
MINUTEMAN PRODUCIBILITY STUDY NO. 3: MEASUREMENT OF DOUBLE SIDED MEMORY DISC Final Report
R. H. Borders 15 Dec. 1964 8 p
(Contract AF 04(694)-402)
(C4-2095/33; AD-454854)

Several gaging principles were evaluated to determine the adaptability of their basic operation to this difficult qualification problem. An optical technique was chosen as the ideal method. Preliminary evaluations showed this method had the required accuracy, but a number of complications and undesirable features were found. A review of the study feasibility resulted in the decision to request cancellation. Author

N65-20869# System Development Corp., Santa Monica, Calif.
STUDIES IN PROBABILISTIC INFORMATION PROCESSING
Richard J. Kaplan and J. Robert Newman 2 Oct. 1964 44 p refs
(SP-1743/000/00; AD-455028)

A theory of probabilistic information processing is outlined, and three experimental studies testing that theory are described. The theory is based on certain principles of the Bayesian statistical decision theory, and it is designed as an aid to human diagnostic decision making. The experiments were concerned with certain types of military diagnostic decisions. In general, the experimental results support the theory. The implications of the theory for practical applications are discussed, and suggestions are made for future research. Author

N65-20873# Stanford Research Inst., Menlo Park, Calif.
GRAPHICAL DATA PROCESSING RESEARCH STUDY AND EXPERIMENTAL INVESTIGATION Quarterly Progress Report No. 6, 1 Oct.–31 Dec. 1964
A. E. Brain, R. O. Duda, H. Fossum, and J. H. Munson Jan. 1965 43 p refs
(Contract DA-36-039-AMC-03247(E))
(Rept.-18; AD-460387)

The MINOS II/SDS 910 interface is now operational, including the ternary buffer, the A-to-D converter and multiplexer. A successful simulation of MINOS II at full scale was achieved with an operating rate of 4 patterns per second; simulation will provide a standard of comparison against which the performance of MINOS II may be checked. Some typical results are given. Three practical problems in upgrading the performance of the 1024-image optical preprocessor are discussed: stability and sensitivity at the diffuser output, and circuit difficulties associated with the storage tube. Author

N65-20979*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TELEMETRY ON-LINE MONITORING, COMPRESSION, AND TRANSMISSION SYSTEM FOR THE MANNED SPACE FLIGHT NETWORK (TOMCAT). VOLUME I: SYSTEMS DESCRIPTION
Sidney S. Lechter Sep. 1964 162 p
(NASA-TM-X-55099; X-546-64-257) CFSTI: HC $5.00/MF $1.00

Ground station equipment and operations and computer program instructions are discussed for the TOMCAT system. This complex, based on the UNIVAC 1218 computer, is designed to fulfill all data handling requirements for the Gemini network. The system includes 8 input and 8 output channels, each providing 18 parallel data lines and the necessary lines for real-time operation. Core storage capacity is 16K 18-bit words. Automatic (computation) program interrupt is available to the flight controller on request. Gemini and Agena spacecraft data are automatically identified for processing on receipt from either one of two pulse-code-modulation (PCM) stations. Summary generation and transmission and parameter printout may be accomplished in either the real-time or the decelerated dump mode. Compressed data are transmitted from PCM station to control center in the real-time mode. Serially telemetered spacecraft data are received at the PCM station, and the parameters associated with vehicle subsystem status and engineering factors are stripped out for parallel retransmission. E.P.V.

N65-21011# George Washington Univ., Washington, D. C. School of Engineering and Applied Science
ANALYZING SELECTED UNITED STATES AIR FORCE DATA SYSTEMS AND DETERMINING SUITABILITY OF DATA FOR RELIABILITY MEASUREMENTS OF AIRCRAFT ENGINES
Thomas Bennett Mc Hugh (M.S. Thesis) Feb. 1964 36 p refs
(AD-608350)

The primary concern was to determine whether present Air Force data systems provide a suitable basis for computing aircraft engine reliability. Certain elements of reliability theory and practice are discussed. Three separate data systems, whose data suggest a usefulness for reliability computations, are evaluated. Both retrospective and prospective testing is considered for testing the accuracy of reliability estimates made from presently available data systems. The exponential function for reliability probability is included. E.E.B.

N65-21052# Army Electronics Labs., Fort Monmouth, N. J. Exploratory Research Div. C
INVESTIGATIONS INTO THE THEORY OF AN ITERATIVE CIRCUIT STORED PROGRAM PARALLEL PROCESSOR (PART I)
Serafino Amoroso Feb. 1965 20 p ref
(ECOM-2552; AD-612889)

The investigation of a highly parallel network of logical modules under control of a stored program is started. A given set of machine instructions is reduced to a minimum without relinquishing any theoretical processing capability. Author

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N65-20137 Joint Publications Research Service, Washington, D. C.

TRANSISTOR CIRCUIT DESIGN (5)

Hsieh-t'ing Ling *In its* Transl. on Communist China's Sci. and Technol., No. 161 19 Mar. 1965 p 88-95 ref Transl. into ENGLISH from Tien-tzu Chi-shu (Shanghai), no. 9, Sep. 1964 p 32-34 (See N65-20134 10-34) CFSTI: $4.00

A practical approximation method—similar to that used for the design of an electronics tube oscillating circuit—was used to resolve the oscillation strength and the working condition of the circuit. Approximations of the characteristic curves of transistor to broken lines led to the expression for the collector-electrode current, followed by calculations of the power index, and the electrical parameter. An example presents the design calculations for an oscillating circuit that requires a useful output power, P = 0.35 watt, for an oscillating frequency of 3 megacycles per second. G.G.

N65-20167 Services Electronics Research Lab., Baldock (England).

A TRANSVERSE WAVE TRAVELLING WAVE TUBE (T.W.T. W.T.)

J. E. Carroll *In its* S.E.R.L. Tech. J., Vol. 15, No. 1, Feb. 1965 [1965] 13 p refs Presented at 5th Intern. Microwave Conf., Paris, Sep. 1964 (See N65-20166 10-16)

Some results of an initial investigation of a transverse wave T.W.T. using slow cyclotron waves are presented. The object of the work is to assess the possibility of producing a high efficiency microwave amplifier from this type of interaction. The experimental tube that is described functions at 2950 Mc/sec with a Brillouin beam operating in the region of 7 kV 200 mA which interacts with a slow-wave circuit composed of a pair of meander lines. At the present stage of the investigation it is concluded that more than 60% efficiency should be a practical possibility but only with a multistage collector. Author

N65-20168 Services Electronics Research Lab., Baldock (England).

A NEW EQUIVALENT CIRCUIT FOR COUPLED CAVITY STRUCTURES

H. J. Curnow *In its* S.E.R.L. Tech. J., Vol. 15, No. 1, Feb. 1965 [1965] 14 p refs Presented at Intern. Microwave Conf., Conf., Paris, Sep. 1964 (See N65-20166 10-16)

Presented is a new equivalent circuit which is useful in understanding the behavior of slot-coupled cavity chain structures. By allowing for the possibility that only a part of the current circulating in each cavity may take part in the coupling, it is possible to account for many of the properties of such structures, and to predict the effect upon them of changes in the structure dimensions. Author

N65-20232 Joint Publications Research Service, Washington, D. C.

EXPERIMENTAL INVESTIGATION OF THE FREQUENCY CHARACTERISTICS OF GAS-DISCHARGE DETECTORS OF SUPERHIGH-FREQUENCY OSCILLATIONS

R. A. Valitov, V. T. Tsarenko, and Yu. Ya. Milenko *In its* Izv. VUZov: Radiophys., Vol. VII, No. 5, 1964 11 Mar. 1965 p 251-256 refs (See N65-20205 10-10) CFSTI: $6.00

A gas-discharge tube with no trimmer elements was constructed for detection of superhigh frequency oscillations in the 20% frequency range. Performances of two waveguide feed-through detector sections were compared with those of a crystal detector; for both models the transmission factor, traveling-wave ratio, and attenuation factor were measured experimentally as a function of frequency. It was concluded that a simple design of a gas-discharge detector can be accomplished by using a standard segment of a waveguide and a glass gas-discharge tube filled with neon, argon, or helium, at a pressure which is a few multiples of 10 mm Hg. Rods of molybdenum or nickel, spaced at a distance of 2 to 5 mm, can be used as electrodes. The transmission factor will be not less than 5 mV/MW at a direct component of the discharge current in the range 2 to 5 ma and load impedances of several times 10 kilohms. J.M.D.

N65-20233 Joint Publications Research Service, Washington, D. C.

EXPERIMENTAL INVESTIGATION OF THE ELECTRODYNAMIC CHARACTERISTICS OF PIN SYSTEMS

P. I. Gos'kov *In its* Izv. VUZov: Radiophys., Vol. VII, No. 5, 1964 11 Mar. 1965 p 257-262 refs (See N65-20205 10-10) CFSTI: $6.00

The results are given of an experimental investigation of the electrodynamic characteristics of a two-row ladder-type system with lugs and of a single-row pin comb. A comparison is made of the results of experimental investigation of the dispersion of the two systems and the coupling impedance of the two-row ladder with the results of calculation. The given systems were investigated by the method of small disturbing bodies. The resonance models of the two-row ladder system contained 3 and 7 periods, and the models of the pin comb had 10 periods. Author

N65-20235 Joint Publications Research Service, Washington, D. C.

STRATIFICATION OF DISCHARGE INSIDE A HOLLOW CATHODE

S. B. Mochenev *In its* Izv. VUZov: Radiophys., Vol. VII, No. 5, 1964 11 Mar. 1965 p 267-269 refs (See N65-20205 10-10) CFSTI: $6.00

This report points out one possible mechanism of the formation of stratification of glow discharge throughout a hollow cathode. Examined is the region of negative glow in a hollow cathode made in the form of an extended cylindrical tube. As direct measurements show, the distribution of the concentration of charged particles over the cross section in that region is close to uniform. Therefore the equation determining the change in concentration along the axis of the cathode becomes one-dimensional. Author

N65-20252# Joint Publications Research Service, Washington, D. C.

IZVESTIYA VUZov: INSTRUMENT BUILDING, VOLUME VII, NO. 6, 1964

24 Mar. 1965 165 p refs Transl. into ENGLISH of Izv. Vysshikh Uchebn. Zavedenii. Priborostr. (Leningrad), v. 7, no. 6, 1964
(JPRS-29269; TT-65-30580) CFSTI: $5.00

Selected articles are presented on electronics, electronic equipment, automatic controls, instrumentation, and structural mechanics. For individual titles see N65-20253–N65-20275.

N65-20255 Joint Publications Research Service, Washington, D. C.
AUTOMATIC INSTRUMENT FOR MEASURING PULSE DURATION AND OSCILLATION FREQUENCY
Sh. Yu. Ismailov and A. M. Smolyarov *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 6, 1964 24 Mar. 1965 p 19–26 refs (See N65-20252 10-09) CFSTI: $5.00

The description of a circuit for an instrument measuring the pulse duration and oscillation frequency with employment of a slaved step by step motor is given. The instrument's characteristics and range of its application are examined. The operating principle of the instrument described herein is based on a comparison of the measured τ_m and pedestal τ_p pulses with balancing of the difference pulse with a high frequency which is followed by adjustment of the mismatch with a step by step motor. Author

N65-20256 Joint Publications Research Service, Washington, D. C.
DEVICE FOR OSCILLOGRAPHIC PRESENTATION OF DISTRIBUTED PARAMETER CONTROL DATA
I. E. Naats *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 6, 1964 24 Mar. 1965 p 27–34 refs (See N65-20252 10-09) CFSTI: $5.00

A device for the recording of distributed parameter control data on an oscillograph tube is proposed. It enables the receipt of definite signals fed into a cathode-ray tube modulator which correspond to the amplitude position of the input signals with respect to the parameter's admissible value zone. The position of the controlled field at every given moment of time is reflected by the aggregate of bright spots on the tube's screen. The device is intended for operation in systems of bypass control. Author

N65-20259 Joint Publications Research Service, Washington, D. C.
AC INTEGRATING UNITS WITH ELECTRONIC SWITCHING
V. I. Gostev *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 6, 1964 24 Mar. 1965 p 48–56 refs (See N65-20252 10-09) CFSTI: $5.00

This work describes two circuits of wideband integrating units—dc integrators—with electronic switching, intended for correcting automatic control and regulatory systems operating on a carrier frequency. The approximate equivalent transfer function of the integrators has been developed. Practical circuits of the integrators and results of the experimental data are shown. Author

N65-20262 Joint Publications Research Service, Washington, D. C.
APPLICATION OF GENERALIZED CHARACTERISTICS IN ANALYZING IMPEDANCE-LOADED MAGNETIC AMPLIFIERS
N. M. Yakovlev *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 6, 1964 24 Mar. 1965 p 72–75 refs (See N65-20252 10-09) CFSTI: $5.00

The design of general characteristics of magnetic amplifiers and their application in determining amplitude and phase of the first harmonic of the current of an impedance-coupled magnetic amplifier with a live load was previously analyzed. In a continuation of this subject, an analysis of an impedance-coupled magnetic amplifier with the operating coil connected in parallel is presented. E.E.B.

N65-20267 Joint Publications Research Service, Washington, D. C.
GEOMETRIC AND ILLUMINATION CHARACTERISTICS OF PHOTOELECTRIC CONVERTERS
V. K. Eliseyev and A. I. Petrenko *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 6, 1964 24 Mar. 1965 p 99–106 refs (See N65-20252 10-09) CFSTI: $5.00

The geometric and illumination characteristics are examined of photoelectric converters which are components of devices designed to convert various kinds of graphic information into electrical signals. Conditions of output signal independence of the position of the reading ray in the field of view of the converter are analyzed, as well as the means of providing the maximum possible signal to noise ratio at its output. Author

N65-20268 Joint Publications Research Service, Washington, D. C.
EXPERIMENTAL STAND FOR INVESTIGATING HEAT TRANSFER PROCESSES
G. P. Buynyachenko *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 6, 1964 24 Mar. 1965 p 107–112 refs (See N65-20252 10-09) CFSTI: $5.00

A test stand, built for experimental study of nonstationary conditions of heat transfer at the boundary between a solid and a fluid medium, is described. The stand includes a means of controlling the temperature at six points of the test sample. For this purpose the stand has two automatic electronic recording potentiometers. One has a range of 0° to 400° C, and the other has 10 ranges of 30° C each with 5° overlap. Experimental studies made with the test stand allowed the determination of internal heat transport parameters from measurements in an asymmetric nonstationary temperature field. E.E.B.

N65-20270 Joint Publications Research Service, Washington, D. C.
AERODYNAMIC RESISTANCE OF MODULE-TYPE RADIOELECTRONIC EQUIPMENT
A. M. Karapetyan *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 6, 1964 24 Mar. 1965 p 116–122 refs (See N65-20252 10-09) CFSTI: $5.00

A method for the determination of aerodynamic resistance of module-type radioelectronic equipment is presented. The test apparatus consisted of a set of plug-in cards with radio parts mounted on one side. Air flowed through the spaces between the cards, with the quantity of air depending on the aerodynamic resistance of the zone. The aerodynamic resistance of the zone was studied in a low-speed wind tunnel, the working section of the tunnel being an organic glass model of a case for a piece of module-type radioelectronic equipment. Details of the experiments and data are included. E.E.B.

N65-20275 Joint Publications Research Service, Washington, D. C.
SLIDING PANEL CONNECTORS IN ELECTRONIC INSTRUMENT ASSEMBLY

A. E. Rogozhkin *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 6, 1964 24 Mar. 1965 p 150–155 refs (See N65-20252 10-09) CFSTI: $5.00

The article examines questions dealing with the utilization of sliding connectors in the assembly of radioelectronic equipment. Results are cited of tests with sliding, braided-wire connectors in a transistorized digital computer. Author

N65-20329# Joint Publications Research Service, Washington, D. C.

A TRANSISTORIZED RC- BANDPASS AMPLIFIER

V. I. Sementsov *In its* Izv. VUZov: Radio Eng., Vol. 7, No. 5, 1964 5 Mar. 1965 p 31–41 refs (See N65-20326 10-10) CFSTI: $5.00

Described is the circuit of an RC amplifier designed with a reactive transistor which makes it possible to obtain a resonant transfer function. Formulas are derived for the resonant frequency, the gain, and the Q factor of the circuit. Experimental results are shown for an amplifier tuned at 108 kc. Author

N65-20335 Joint Publications Research Service, Washington, D. C.

FREQUENCY STABILITY OF A QUARTZ OSCILLATOR AND THE EFFECT OF HIGHER HARMONICS

A. F. Plonskiy *In its* Izv. VUZov: Radio Eng., Vol. 7, No. 5, 1964 5 Mar. 1965 p 99–108 refs (See N65-20326 10-10) CFSTI: $5.00

The effect of higher harmonics on the frequency of a quartz oscillator is evaluated; a method is proposed for improving the stability by compensating this effect with subharmonics through pulse excitation. The results of an experiment are used to prove that such a generator has an exceptionally low instability. Author

N65-20371# Utah Univ., Salt Lake City. Microwave Device and Physical Electronics Lab.

CYCLOTRON WAVE DEVICES STUDY Quarterly Progress Report, 1 Jul.–30 Sep. 1964

T. Kao, D. C. Watson, C. H. Durney, C. C. Johnson, and R. W. Grow [1964] 24 p ref

(Contract DA-36-039-AMC-02372(E))

(QPR-5; AD-454909)

The cyclotron-synthronous wave amplifier was reassembled with a flat-cathode immersed flow gun. Special attention was directed toward obtaining an accurate measure of the cavity coupling coefficients and eliminating pump section resonances. The cyclotron-wave power converter was operated successfully at low voltages. Despite secondary emission problems, conversion efficiencies of up to 50% were obtained. Author

N65-20374# Cornell Univ., Ithaca, N. Y. Electrical Engineering Research Lab.

DESIGN OF DIVIDED-BAND AMPLIFIERS Technical Report No. 83

K. Kleckner Dec. 1964 39 p refs

(Contract DA-36-039-AMC-00034(E))

(EERL-29; AD-610319)

This report deals with the engineering design of uhf multichannel or divided-band amplifiers. The problems of tube selection and filter design in meeting specified gain and bandwidth requirements are discussed in detail. Several representative types of high-transconductance triodes are considered, as are the circuit restrictions that such tubes impose. Fourth-order Butterworth filters are shown to be entirely adequate to perform band-splitting and recombination, and explicit design formulas are presented for all filter-circuit elements. Performance limitations imposed by currently available tube types are illustrated, and it is shown that the development of tubes with lower output capacitances (even at the expense of larger input capacitances) would permit more efficient amplifier performance. Author

N65-20393 Library of Congress, Washington, D. C. Aerospace Technology Div.

SOVIET RESEARCH ON MICROWAVE POWER GENERATION

In its Foreign Sci. Bull., Vol. 1, No. 1, Jan. 1965 [1965] p 8–18 refs (See N65-20390 10-34)

Soviet scientists are continuing their work on the development of high-power tubes for continuous-wave operation in the decimeter-wave band. It is their opinion that high-power oscillations can be produced efficiently only by electronic devices using processes which occur in constant (crossed) magnetic and electric fields. The first such device, the "planotron," was reported in the fall of 1962. It was followed by the "nigotron" system, reported in 1964, which is based on the planotron principle but has improved characteristics. The importance of these developments for electric-power transmission—both wireless and through waveguides—is stressed. Author

N65-20444# Radio Corp. of America, Harrison, N. J. Electron Tube Div.

RESEARCH STUDIES OF QUANTUM DETECTORS AND MIXERS Final Report, 1 Jul.–30 Aug. 1964

D. Blattner and J. Ruedy [1964] 76 p refs

(Contract DA-36-039-SC-90846)

(AD-455124)

Photomultiplier tubes capable of extending the low-noise gain of secondary emission multiplication to microwave frequencies were designed and operated. The tubes consisted of a semitransparent photocathode sensitive to the required spectral region, a multistage structure of transmission secondary emission dynodes, and a helical output coupler through which the electrons from the last dynode are focused. Experimental results are reported for tubes having a center frequency of 1.5 Gc and a bandwidth of 1.0 Gc. Tests indicate that any deterioration of modulation by the secondary emission multiplication process is small compared to the gain achieved in the dynodes. The noise is that predicted from the statistics of photo- and secondary-emission. For light wavelengths where efficient photocathodes can be constructed, the sensitivity of this tube approaches that of an ideal detector. Calculations indicate that scaling of this tube design to frequencies as high as K_a band is possible. Author

N65-20545# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE SUBSTANTIATION OF A METHOD FOR THE CALCULATION OF A SCREENED ASYNCHRONOUS ELECTRIC MOTOR WITH CONDUCTIVE LIQUID IN GAP

A. V. Ivanov-Smolenskiy and G. S. Tamoyan 9 Mar. 1965 17 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Energ. i Transp. no. 4, 1964 p 466–473

(FTD-TT-65-174/1+2; AD-612420)

Substantiated is a method for the calculation of a screened asynchronous electric motor with conductive liquid in gap between rotor and stator. Mathematical formulas are given for basic parameters of the motor; vector diagram and substitution scheme are given. Author

N65-20553# Stanford Research Inst., Menlo Park, Calif. Electromagnetic Techniques Lab.
HIGH POWER MICROWAVE FILTERS FOR THE SUPPRESSION OF SPURIOUS ENERGY Final Report, 15 Sep. 1963–14 Sep. 1964
Leo Young, B. M. Schiffman, E. G. Cristal, and D. B. Weller
Griffiss AFB, N.Y., RADC, Feb. 1965 176 p refs
(Contract AF 30(602)-3174)
(RADC-TR-64-515; AD-612893)

A new circuit for the 3-dB short-slot sidewall coupler was tested as a harmonic pad. High-power tests indicate that the short-slot side-wall coupler has a pulse power capacity of approximately 72% of regular waveguide. A new type of low-pass waveguide filter that attenuates by dissipation and has a very wide stop band is described. A trapped-mode bandpass filter is described, in which the spurious responses due to higher-order resonances are eliminated by heavily damping all but the fundamental resonance. A nonreflecting diplexer-type waveguide filter was synthesized, using two complementary filters, one bandpass filter and one band-stop filter. Numerical data are presented on the characteristic impedance of coaxial lines consisting of a circular inner conductor and a rectangular outer conductor. The modes of a confocal resonator are found to be separable because of their unique transverse spatial distribution. Author

N65-20559# Honeywell, Inc., Hopkins, Minn. Ordnance Div.
LOW INPUT VOLTAGE CONVERSION Second Quarterly Progress Report, 1 Jun.–31 Aug. 1964
John T. Lingle and Kenneth J. Jenson [1964] 45 p
(Contract DA-28-043-AMC-00030(E))
(Rept.-II; AD-611269)

Effort was directed towards circuit design to improve the switching characteristics of the current feedback oscillator so that efficient operation can be achieved at higher frequencies. Experiments showed that more rapid switching can be obtained by back biasing the oscillator transistors to a much higher voltage for a short interval during switching. New circuitry has been designed with low loss reactive components to provide the desired back bias characteristics. Measurements show that the overall efficiency of a converter-regulator operating at 600 cps is increased by 5% when the improved biasing circuitry is incorporated. A low input voltage converter-regulator model was fabricated using the new bias circuitry. Performance measurements show that this converter-regulator achieves peak efficiencies above 85% with a 100-W load when operated from a laboratory power supply. Efficiencies above 80% were maintained at 200-W load and efficiencies above 75% were maintained at 250-W load. Increased converter switching speeds focused attention upon the effects of input lead inductance. Experiments showed that long input leads generate excessive input voltage spikes which increase switching losses. Author

N65-20563# National Bureau of Standards, Washington, D. C.
PROJECT FIST: FAULT ISOLATION BY SEMI-AUTOMATIC TECHNIQUES
Gustave Shapiro, Owen B. Laug, George J. Rogers, and P. Michael Fulcomer, Jr. 17 Sep. 1964 80 p refs
(BuShips Order 1700R-648-59)
(NBS-Monograph-83) GPO: $0.55

The system consists of test points and associated circuitry built into the prime equipment, and a small, hand-carried, general-purpose test instrument. The test points are located on a test panel, arranged to permit rapid checking of the modules in logical sequence. Fault isolation is accomplished by testing the dynamic performance of each module with a test instrument which is basically a device for comparing the peak-to-peak amplitudes of two periodic voltage waveforms. Since many circuit properties other than voltage must be measured, transformation networks are provided to convert the characteristic being measured to a periodic voltage within the range of the test instrument. This report describes the hardware required and discusses practical ways in which the necessary circuitry can be built into the prime equipment. A prototype test instrument capable of simultaneously testing four characteristics of the module or of its stimuli is described in detail. Author

N65-20584 Joint Publications Research Service, Washington, D. C.
MEASUREMENT OF RESISTANCE OF ELECTRODES OF CRYSTAL TUBE
Shu-huai Shih *In its* Transl. on Communist China's Sci. and Technol., No. 162 23 Mar. 1965 p 18–22 refs Transl. into ENGLISH from Tien-tzu Chi-shu (Shanghai), no. 8, Aug. 1964 p 29–30 (See N65-20582 10-34) CFSTI: $2.00

The base resistance or total resistance of the crystal tube is discussed and the importance of its measurement emphasized. Four methods for its measurement are outlined and circuit diagrams are presented. A representative problem is solved for the total resistance and the capacitance of the crystal tube. E.E.B.

N65-20585 Joint Publications Research Service, Washington, D. C.
CRYSTAL TUBE MIXER CIRCUIT (IV)
Hsieh-t'ing Ling *In its* Transl. on Communist China's Sci. and Technol., No. 162 23 Mar. 1965 p 23–28 refs Transl. into ENGLISH from Tien-tzu Chi-shu (Shanghai), no. 8, Aug. 1964 p 32–34 (See N65-20582 10-34) CFSTI: $2.00

The characteristics of the crystal tube mixer can be analyzed by the same method used to analyze the amplifier characteristics. The equivalent circuit of the mixer is obtained through the nonlinear characteristics of the crystal tube. The analysis of the mixer admittance is discussed. Diagrams for the mixer circuit are included. Also, a graphical solution for the determination of the intermediate frequency signal current is presented. E.E.B.

N65-20591# General Electric Co., Owensboro, Ky. Tube Dept.
C-BAND TRIODE-CAVITY OSCILLATORS, PRODUCTION ENGINEERING MEASURE Quarterly Progress Report, 1 Sep.–30 Nov. 1964
J. D. Marshall [1964] 24 p
(Contract DA-36-039-AMC-01474(E))
(QPR-6; AD-610165)

Assembly of triode-cavity oscillators for the pilot production phase was completed. Facilities for assembling and testing five units each of the cw oscillator and of the pulsed oscillator are described, and modifications of testing procedures to increase testing efficiency are given for both types of oscillators. M.P.G.

N65-20651*# Battelle Memorial Inst., Columbus, Ohio.
THE REVISED TEST PROCEDURE FOR JPL TEST NO. 617, PHASE II TO JET PROPULSION LABORATORY Final Report
C. L. Hanks and D. J. Hamman 25 Jan. 1965 124 p Prepared for JPL
(Contracts NAS7-100; JPL-950458)
(NASA-CR-57545) CFSTI: HC $4.00/MF $1.00

Complete test procedures for studying the reliability of electronic components in a nuclear-radiation environment, compatible with a spacecraft utilizing nuclear electric propulsion or auxiliary power, are presented. The major program effort centers on the behavior of selected electronic parts in a specified radiation environment over a 10000-hour period. The particular environment is 100° C, under vacuum, at radiation exposure rates of 1×10^9 fast n cm^{-2} hr^{-1} and 1×10^5 ergs $g^{-1}(C)$ hr^{-1} of gamma radiation. The test plan allows for the separation of vacuum effects and radiation effects; some indication of temperature effects; and comparison between effects of long-term, low-level, radiation exposure and the long-term effects of short-term, high-level radiation exposure. An automatic data recording system was used to faciliate data recording and processing of the performed measurements. G.G.

N65-20700# Airtron, Inc., Morris Plains, N. J.
DUPLEXER FOR SIDE-LOOKING RADAR First Quarterly Report, 1 Jul.–30 Sep. 1964
Kenneth A. Lehman, J. W. Nielsen, and E. Wantuch Ft. Monmouth, N.J., Army Electron. Labs., Oct. 1964 37 p
(Contract DA-28-043-AMC-00280(E))
(R11-460; AD-454808)

A three-cavity limiter was designed in which the middle resonator is a single crystal YIG sphere. This unit met the insertion loss and bandwidth requirements at low power. A three-port circulator was designed. Six ferrite compositions were tested for peak power handling capability. Substantial improvements were obtained by utilizing a hot pressing technique in the preparation of the magnesium, manganese ferrite body. Data show satisfactory power handling capability of one composition in excess of 200-kW peak with a 0.001 duty cycle. A four-port differential phase shift circulator model was designed and constructed. Several ferrite compositions were tested at low power level. Author

N65-20768# General Dynamics Corp., Groton, Conn. Electric Boat Div.
THE CROSS-OVER DETECTOR
Mahmoud Melehy Sep. 1964 37 p refs
(Contract Nonr-2512(00))
(U417-64-031; AD-454792)

This report describes the development of a low hysteresis zero crossover detector which consists essentially of (1) a tunnel diode detector stage; (2) an isolation stage; (3) an oscillation-suppressor stage; and (4) a Schmitt trigger stage. The last three stages use only transistors operated as shock-wave amplifiers to maintain sharp leading edges. The output voltage is a 12-volt square wave with a rise time of 60 nanoseconds. The maximum lag in crossover position of the output is estimated to be smaller than 100 nanoseconds. The tunnel diode detector clips signals with amplitudes smaller than 1 millivolt in a frequency band between 0 and 100 kc. The complete circuit operates over a frequency band from 10 cps to 60 kc. Photographs of waveforms at various points in the circuit are included. Author

N65-20913# Radio Corp. of America, Harrison, N. J. Microwave Tube Operations Dept.
DEVELOPMENT OF A C-BAND SOLID-STATE GENERATOR Second Quarterly Progress Report, 1 Aug.–31 Oct. 1964
E. Diamond and C. Sun (1964) 20 p
(Contract DA-28-043-AMC-00088(E))
(Rept.-2; AD-459581)

The power source consists of a transistor oscillator followed by three stages of frequency multiplication. Tests on the transistor oscillator gave a power output of 2.4 to 2.8 watts at efficiencies of 31% to 38% over a 410 to 470 Mc frequency range. A broadband amplifier was designed to provide a power output of 6 to 8 watts. This amplifier, driven by a low power oscillator, will be used if oscillators giving similar output power prove impractical. The three stages of frequency multiplication were designed. Test results on the first doubler were: output frequency—2.5 Gc; efficiency—60%; bandwidth—20%; and power output—2.4 watts. Author

N65-20924# Texas Instruments, Inc., Dallas.
LOW NOISE L-BAND TRANSISTOR Quarterly Progress Report No. 2, 15 Aug.–15 Nov. 1964
Doyle S. Granberry, Roger R. Webster, and R. L. Petritz 15 Dec. 1964 19 p
(Contract DA-28-043-AMC-00119(E))
(TI-03-64-87; AD-458427)

Smaller emitter areas were achieved and work continued on reducing r_b. The f_T discrepancy problem was solved, although further work on f_T is required. The base resistance problem is discussed, particularly the base contact resistance. Significant improvement is reported in this parameter. Improvement is also reported in noise figure as well as in noise figure measurement techniques. Author

N65-20938# M-O Valve Co., Ltd. (Gt. Brit.) Research Labs.
BROADBAND LOW NOISE TRAVELLING WAVE TUBES Second Annual Report
C. B. Smith 17 Nov. 1964 30 p refs
(Rept-14701C; AD-455259)

The object of the project described is to investigate the possibility of extending the bandwidth of the travelling wave tube, VX3363, from its present range of 500 to 1000 Mc/s to 150 to 1000 Mc/s. The initial work was concentrated on the measurement of existing samples of VX3350 and on the coupling system. Once the wider band coupling system was available, work was directed to increasing the gain bandwidth. Apart from the rescaling necessary to suit the changed beam conditions, only minor alterations have been made to the noise design of the electron gun, but the results encourage the view that the noise bandwidth may not prove a serious difficulty. Author

N65-20962# Joint Publications Research Service, Washington, D. C.
ELECTRICAL COMPARATORS FOR PRECISE MEASUREMENTS OF CURRENT, VOLTAGE AND POWER
T. B. Rozhdestvenskaya 31 Mar. 1965 205 p refs Transl. into ENGLISH from the book "Elektricheskiye Komparatory Dlya Tochnykh Izmeraniy Toka, Napryazheniya i Moshchnosti" Moscow, 1964 187 p
(JPRS-29373; TT-65-30626) CFSTI: $6.00

Precise methods and instruments for the measurement of current, voltage, and power at high frequencies in the audio and ultrasonic ranges are described. Classification charts and block diagrams of the instruments, and an analysis of the errors and general expressions for their determination are also given. The conditions of stable operation of electromechanical comparators and transformers are analyzed. Also, factors influencing the results of measurements are included. The book is intended for engineering and technical workers of scientific research, calibration, and plant measurement laboratories. E.E.B.

N65-21008# Watkins-Johnson Co., Palo Alto, Calif.
DEVELOPMENT OF A DOUBLE OCTAVE BANDWIDTH TRAVELING-WAVE TUBE AMPLIFIER Technical Report No. 3
B. P. Israelsen and F. T. Mauch Griffiss AFB, N.Y., RADC, Feb. 1965 21 p
(Contract AF 30(602)-3261)
(RADC-TR-64-537; AD-612717)

The purpose of the program is the attainment of low-noise amplification over two octaves in a single traveling-wave tube. Noise figure is to be less than 6 dB from 2.0 to 8.0 Gc, with a minimum of 10 mW saturated power output. The work described in this report has been aimed primarily at reducing rf losses that occur in the input, since these losses add directly to the noise figure of the amplifier. These losses result from rf radiation at the pin seal, and from the insertion loss of presently available dc returns. The cathode coating has also been investigated. Two new cathode binder materials were evaluated with no significant effect upon noise figure of the amplifier. Author

N65-21028# Westinghouse Electric Corp., Elkridge, Md. Molecular Electronics Div.
IMPROVEMENT OF PRODUCTION TECHNIQUES TO INCREASE THE RELIABILITY OF SILICON PLANAR EPITAXIAL: TRANSISTOR (WX4001), LOGIC GATE (WM 201), FLIP-FLOP (WM 202), AC BINARY (WM 213). PRODUCTION ENGINEERING MEASURE, OCTOBER 1–DECEMBER 31, 1965
A. T. Hamill [1964] 30 p
(Contract DA-36-039-AMC-03617(E))
(AD-612756)

Reliability tests were completed and extensive failure analyses were performed; emphasis was upon failure analysis with most effort being placed on the WX 4001 device. The majority of the failures were thermally induced channels, followed by open bonds due to formation of purple plague at high temperatures in the step stress tests. The failure modes established confirmed the validity of the process improvements incorporated in present processing. Author

N65-21055# Cinch Mfg. Co., Chicago, Ill. Research and Development Dept.
PRINTED CIRCUIT CONNECTORS FOR MICROASSEMBLIES (PHASE II) Semiannual Progress Report, 1 Jul. 1964–1 Jan. 1965
Howard E. Dwan [1965] 69 p refs
(Contract DA-28-043-AMC-00294(E))
(AD-612890)

One task provides for the development of a 20-contact receptacle, 0.393 in. square and 0.115 in. high. Details of the planned evaluation program are presented. The second task provides for the development of a two-part 36-contact and an 80-contact connector for encapsulated stacked wafer assemblies of 0.310 in. square and 0.600 in. square microwafer. A discussion of the planned evaluation program is presented. The third provides for the design, fabrication and evaluation of a connector for testing of individual microcircuit wafers. Author

N65-21069# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy).
PROGRESS ON A PRESSURIZED SPARK GAP [PROGETTO DI UNA SPARK-GAP PRESSURIZZATA]
L. Cerioni, F. Losciale, and G. Ubaldini 26 Jan. 1965 12 p ref In ITALIAN *Its* Nota Interna No. 268
(LNF-6512)

A pressurized spark gap with a jitter of about 2 or 3 nanoseconds, a breakdown voltage of 14 KV, and a working voltage of 13 KV under 1.5 atmospheres of nitrogen, is described. Trans. by P.F.E.

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N65-20205# Joint Publications Research Service, Washington, D. C.
IZVESTIYA VUZov: RADIOPHYSICS, NO. 5, 1964
11 Mar. 1965 283 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Radiofiz. (Gor'kiy), v. vii, no. 5, Sep.–Oct. 1964 p 817–1011
(JPRS-29075; TT-65-30487) CFSTI: $6.00

Selected articles in radio engineering, electromagnetic radiation, plasma physics, electronics, and mathematical physics are presented. For individual titles see N65-20206–N65-20236.

N65-20218 Joint Publications Research Service, Washington, D. C.
A DISTRIBUTED COUPLER FOR A FAST CYCLOTRON WAVE
A. S. Roshal' and V. S. Popov *In its* Izv. VUZov: Radiophys., Vol. VII, No. 5, 1964 11 Mar. 1965 p 122–135 refs (See N65-20205 10-10) CFSTI: $6.00

The present article treats the frequency characteristics and estimates the width of the matching band (elimination of noise) for a distributed coupler for a fast cyclotron wave. The matching band is understood to be the range of frequencies in which not less than half of the input power of the signal is converted to electron flux, while the noise elimination band is taken to be the frequency range in which input noise of the flux is reduced to a set level which is specified for particular cases. The coupler is presented in the form of an equivalent line, where L and C are the inductance and capacitance of a unit length of line, and I_c and V_c are the line current and voltage. It is assumed that the field created by the line is linearly polarized ($E_y = 0$, $E_z = 0$, $E_x \neq 0$), space charge is absent, and the beam is infinitely thin. Author

N65-20219 Joint Publications Research Service, Washington, D. C.
FORCED SYNCHRONIZATION OF A SELF-EXCITED OSCILLATOR WITH DELAYED FEEDBACK
V. P. Rubanik and P. F. Yarema *In its* Izv. VUZov: Radiophys., Vol. VII, No. 5, 1964 11 Mar. 1965 p 136–148 refs (See N65-20205 10-10) CFSTI: $6.00

Forced synchronization of a self-excited oscillator with delayed feedback was studied in the cases of large delay and of subharmonic resonance. The circuit is shown for the simple vacuum-tube oscillator used in the investigation. Differential equations are presented which describe the forced oscillation of the tube; the equations were modified by introducing a quadratic equation for the characteristic curve of the tube. The differential equations were solved by a process of averaging the amplitude and phase equations. For conditions of major resonance, stability of the stationary modes was studied. The effects of small and large feedback delays on the synchronization process were analyzed for the case of subharmonic resonance. J.M.D.

N65-20220 Joint Publications Research Service, Washington, D. C.
THEORY OF SYNCHRONIZATION OF A PUSHING-FORCE OSCILLATOR
V. I. Goryunov *In its* Izv. VUZov: Radiophys., Vol. VII, No. 5, 1964 11 Mar. 1965 p 149–162 refs (See N65-20205 10-10) CFSTI: $6.00

The author examines the existence and stability of the periodic solution (with the period of the external emf) for a pushing-force oscillator as illustrated by a vacuum-tube oscillator with Z-response and a sawtooth external emf placed in the plate circuit. Resonance curves are plotted and the limits of the stability region are determined. Author

N65-20221 Joint Publications Research Service, Washington, D. C.
NONLINEAR ANALYSIS OF A QUASI-HARMONIC SELF-EXCITED OSCILLATOR USING A TRANSISTOR IN UNDER-VOLTAGED CONDITIONS
I. N. Vazhenin *In its* Izv. VUZov: Radiophys., Vol. VII, No. 5, 1964 11 Mar. 1965 p 163–176 refs (See N65-20205 10-10) CFSTI: $6.00

The author carries out a nonlinear analysis for a self-excited oscillator using a transistor in undervoltaged conditions, taking account of the inertial properties of the transistor. Formulas for an engineering calculation of an oscillator operating at low frequencies as well as at frequencies comparable to the critical one are given. Results of calculations were experimentally verified. Author

N65-20222 Joint Publications Research Service, Washington, D. C.
DETERMINATION OF THE CHARACTERISTICS OF NON-LINEAR OBJECTS DURING THEIR NORMAL OPERATION
B. A. Aref'yev *In its* Izv. VUZov: Radiophys., Vol. VII, No. 5, 1964 11 Mar. 1965 p 177–187 refs (See N65-20205 10-10) CFSTI: $6.00

A method of determination of the characteristics of nonlinear objects during their normal operation according to the statistical properties of the input and output signals is examined. The mathematical calculating model of the object is represented by series-connected inertial and nonlinear elements. The parameters of these elements are determined from a recording of one realization of the process. Author

N65-20223 Joint Publications Research Service, Washington, D. C.
DYNAMICS OF A VERY SIMPLE STEP-BY-STEP OPTIMIZING SYSTEM
N. N. Leonov *In its* Izv. VUZov: Radiophys., Vol. VII, No. 5, 1964 11 Mar. 1965 p 188–207 refs (See N65-20205 10-10) CFSTI: $6.00

The operating conditions of a very simple optimizing system with step by step search are investigated by means of the pointwise transformation method. The existence of a continual set of periodic operating conditions of the systems has been established, and their dependence on the initial conditions has been determined. Author

N65-20224 Joint Publications Research Service, Washington, D. C.
THEORY OF RECIRCULATION STORAGE DEVICES AND GENERATORS
M. Ya. Eyngorin *In its* Izv. VUZov: Radiophys., Vol. VII, No. 5, 1964 11 Mar. 1965 p 208–224 refs (See N65-20205 10-10) CFSTI: $6.00

The theory of new types of N-dimensional pulse generators, computers and storage devices which can be used in series and parallel computers and control devices is examined. A geometrical interpretation of these devices is given and certain examples of their modelling by means of ferrite cores are presented. Author

N65-20234 Joint Publications Research Service, Washington, D. C.
CALCULATION OF THE INTERACTION OF AN ELECTRON FLUX WITH THE FIELD OF A TRAVELING WAVE IN CROSSED FIELDS AT FINITE DIMENSIONS OF THE INTERACTION SPACE
M. N. Kulikov and V. S. Stal'makhov *In its* Izv. VUZov: Radiophys., Vol. VII, No. 5, 1964 11 Mar. 1965 p 263–266 refs (See N65-20205 10-10) CFSTI: $6.00

For rectilinear electron fluxes of a finite thickness, having a small density of the space charge ($\omega_p << \omega_c$, where ω_p is the plasma frequency and ω_c the cyclotron frequency), an analysis was made by the field theory method in linear approximation of the interaction of the field with a moderating system with consideration of finite dimensions of the interaction space and the position of the electron flux in it. This method is more rigorous than the method based on calculation of disturbance of the field of a moderating system by high-frequency current of a beam (perturbation technique). Author

N65-20236 Joint Publications Research Service, Washington, D. C.
ANALYSIS OF SYSTEMS WITH MODULABLE PARAMETERS AND OF CERTAIN NONLINEAR SYSTEMS BY MEANS OF ORIENTED GRAPHS
V. S. Emkin *In its* Izv. VUZov: Radiophys., Vol. VII, No. 5, 1964 11 Mar. 1965 p 270–274 refs (See N65-20205 10-10) CFSTI: $6.00

Oriented graphs are shown to be useful in simplifying investigation of linear and nonlinear circuit systems which have periodically modulable parameters. Logic of the method is based on partitioning a circuit with variable parameters into a circuit with constant parameters and a circuit with purely periodic parameters; the latter is considered as a nonstationary feedback circuit that embraces part of the former circuit. Two examples are worked. In one, the transmission factor is calculated for a modulable feedback system with two frequencies and depths of modulation. In the second, the interaction is characterized for the signals in a converter on a nonlinear capacitance with two fundamental frequencies in the presence of strong input signals. J.M.D.

N65-20254 Joint Publications Research Service, Washington, D. C.
DETERMINATION OF REQUISITE SCANNING TIME FOR RANDOM PROCESS FREQUENCY SPECTRUM
V. M. Chernitser *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 6, 1964 24 Mar. 1965 p 10–18 refs (See N65-20252 10-09) CFSTI: $5.00

The problem concerning the spectrum analysis of a continuous, aperiodic process sector was examined. Criteria for determination of the duration of the process in question, assuring the assigned preciseness of results with simultaneous scan and with sequential scan, are proposed. Author

N65-20257 Joint Publications Research Service, Washington, D. C.
THE USE OF A SELF-ADJUSTING MATHEMATICAL MODEL FOR DETERMINING PARAMETERS OF CORRECTIVE FEEDBACK IN AUTOMATIC CONTROL SYSTEMS

Yu. A. Lukomskiy and O. N. Aronov *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 6, 1964 24 Mar. 1965 p 35–42 refs (See N65-20252 10-09) CFSTI: $5.00

One of the fundamental problems to be solved in the mathematical modeling of automatic control systems using analog computers is the selection of optimal parameters for the corrective feedback. This problem may be reduced to a multiple solution of original differential equations with different feedback parameters and evaluation of the nature of change of one or several generalized coordinates of the system by the use of operators. However, this is connected with a number of inherent disadvantages, such as the large expenditure of machine search time and the subjectivity of evaluating the optimal process, and requires highly qualified operators to work with the computer. Such disadvantages may be removed if the search for optimal parameters of corrective feedback is automated by using a method of self-adjusting mathematical models. The use of such a method is illustrated. E.E.B.

N65-20258 Joint Publications Research Service, Washington, D. C.

DESIGN OF TRANSIENT PROCESSES IN ELECTRICAL NETWORKS WITH ANY NUMBER OF IDENTICAL RC-CIRCUITS

N. Ya. Likhttsinder *In its* Izv VUZov: Instr. Bldg., Vol. VII, No. 6, 1964 24 Mar. 1965 p 43–57 refs (See N65-20252 10-09) CFSTI: $5.00

The problem of determining the operating voltage in the last stage of an electrical network consisting of any number of identical RC-circuits, without setting up a system of differential equations and going through the operation of expanding the determinants of the k-th order, is examined. Recommendations are given for the calculation of the transient voltages in such a network by the method of approximations. E.E.B.

N65-20260 Joint Publications Research Service, Washington, D. C.

A METHOD OF SYNTHESIZING SEQUENTIAL NETWORKS

O. B. Babeyev *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 6, 1964 24 Mar. 1965 p 57–63 refs (See N65-20252 10-09) CFSTI: $5.00

A method is presented for synthesizing sequential networks, suitable for application in engineering practice in planning and designing automated industrial systems with asynchronic logical elements. Examples of synthesizing relay networks are given. Author

N65-20263 Joint Publications Research Service, Washington, D. C.

CONDITIONAL DENSITY OF OVERSHOOTS IN RANDOM PROCESSES WITH CENTRALIZED REGULATION AND CONTROL

A. D. Bolychevtsev *In its* Izv. VUZov: Instr. Bldg., Vol. VII, no. 6, 1964 24 Mar. 1965 p 76–78 refs (See N65-20252 10-09) CFSTI: $5.00

A general equation was derived previously for the conditional density of overshoots of a random, steady-state function at a predetermined level. In problems of centralized control, the construction of an optimal control algorithm is related to the study of the behavior of the conditional density of overshoots beyond the point of correction. In the corrective action of the derivative form the behavior of the conditional density of overshoots beyond the point of correction is shown to be easily reproduced by graphic construction. E.E.B.

N65-20264 Joint Publications Research Service, Washington, D. C.

SYNTHESIS OF DYNAMIC CHARACTERISTICS OF SYSTEMS FOR CONVERTING NAVIGATIONAL DATA INTO VISUAL INDICATIONS

I. B. Chelpanov *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 6, 1964 24 Mar. 1965 p 79–84 refs (See N65-20252 10-09) CFSTI: $5.00

The problem of finding the characteristics of a device that would optimally convert a signal from a nonideal navigational instrument is examined from the viewpoint of random signal filter theory. It is assumed that the navigational system is not connected to the autopilot system. The problem reduces to solving an integral equation of the first kind. Author

N65-20298# Illinois Univ., Urbana. Coordinated Science Lab.

LIMIT CYCLES IN A CERTAIN CLASS OF SAMPLED-DATA CONTROL SYSTEMS

Ronald A. Werner Dec. 1964 96 p refs

(Contracts DA-28-043-AMC-00073(E); AF 49(638)-1383) (R-238; AD-610099)

This paper discusses periodic, unforced solutions (called limit cycle solutions) to the state and output equations of a certain class of nonlinear sampled-data control systems. The class of systems consists of a linear plant, a single nonlinearity, a sample and hold element and a single feedback loop. Two different methods are given for determining the possible existence and the solutions for the limit cycles. An approximate method for determining possible existence and output solutions for limit cycles is also given. Finally, a certain kind of stability of limit cycle solutions is defined, and sufficient conditions for the stability and instability of limit cycles are developed. Author

N65-20326# Joint Publications Research Service, Washington, D. C.

IZVESTIYA VUZov: RADIO ENGINEERING, VOLUME VII, NO. 5, 1964

5 Mar. 1965 169 p refs Transl. into ENGLISH of Izv. Vyssh. Uchebn. Zaved. Radiotekhn. (Kiev), v. 7, no. 5, Sep.–Oct. 1964 p 543–646

(JPRS-29006; TT-65-30453) CFSTI: $5.00

Selected topics in radio engineering, physics, and mathematics on subjects closely allied to the study of electromagnetic wave propagation are presented. For individual titles see N65-20327–N65-20345.

N65-20327 Joint Publications Research Service, Washington, D. C.

DEVELOPMENT OF THE PHASE-PULSE METHOD FOR SECOND-ORDER QUASI-CONSERVATIVE SYSTEMS WITH A NON-LINEAR REACTANCE

K. A. Samoylo *In its* Izv. VUZov: Radio Eng., Vol. 7, No. 5, 1964 5 Mar. 1965 p 1–16 refs (See N65-20326 10-10) CFSTI: $5.00

A method is proposed for calculating a second-order quasi-conservative oscillatory system with any nonlinearity. No special functions other than trigonometry are required for the calculation. Transient processes can be analyzed with the aid of differential equations which describe the amplitude and the phase of oscillation. E.E.B.

N65-20331 Joint Publications Research Service, Washington, D. C.

ERRORS IN TWO OSCILLOGRAPHIC METHODS

A. G. Golubkov *In its* Izv. VUZov: Radio Eng., Vol. 7, No. 5, 1964 5 Mar. 1965 p 52–67 refs (See N65-20326 10-10) CFSTI: $5.00

The direct oscillographic method and a method which uses reference pulses are compared by classifying and evaluating the errors. The obtained data can be useful in estimating the accuracy of pickup devices with finite dimensions, automatic regulation systems, etc. Author

N65-20336 Joint Publications Research Service, Washington, D. C.

ANALYSIS OF ELECTRONIC CIRCUITS BY PARTIAL EXCLUSION OF COMPONENT NODES IN MULTIPOLES

Yu. V. Kovalchuk-Ivanyuk *In its* Izv. VUZov: Radio Eng., Vol. 7, No. 5, 1964 5 Mar. 1965 p 109–116 refs (See N65-20326 10-10) CFSTI: $5.00

A method is developed for analyzing linear circuits with active elements by means of the admittance matrix. It is shown how the admittance matrix of a circuit is set up where composite multipoles are separated. The latter are described in terms of equivalent parameters by way of excluding their internal nodes. Author

N65-20337 Joint Publications Research Service, Washington, D. C.

OSCILLATOR FREQUENCY REGULATION BY MEANS OF AN AUTOMATIC PHASE CONTROL CIRCUIT WITH A BLOCKING CAPACITOR IN ITS FEEDBACK LOOP

F. A. Pevzner *In its* Izv. VUZov: Radio Eng., Vol. 7, No. 5, 1964 5 Mar. 1965 p 117–122 ref (See N65-20326 10-10) CFSTI: $5.00

The basic arrangement for oscillator frequency regulation by means of an automatic phase control circuit with a blocking capacitor in the feedback loop is discussed. The relation between the existing frequency difference of the oscillators and the circuit parameters is expressed in operational form. The reduction of tracking error by proper selection of certain parameters and the conditions for preventing the CR-filter from reducing the maximum allowable rate of linear frequency modulation are included. E.E.B.

N65-20338 Joint Publications Research Service, Washington, D. C.

ANALYSIS OF TRANSIENT PROCESSES IN AN INTERMEDIATE-FREQUENCY BANDPASS AMPLIFIER WITH INSTANTANEOUS AUTOMATIC GAIN CONTROL ALONG THE RADIO PULSE ENVELOPE AT HIGH SIGNAL LEVELS

V. M. Volkov and A. G. Novin'kov *In its* Izv. VUZov: Radio Eng., Vol. 7, No. 5, 1964 5 Mar. 1965 p 123–128 refs (See N65-20326 10-10) CFSTI: $5.00

The calculation of transients in an intermediate-frequency bandpass amplifier with instantaneous automatic gain control along the radio pulse envelope at high signal levels is developed. It is shown that when the bandwidth of the stage remains constant but the capacitance increases, the amplified radio pulse stabilizes in a shorter time while the parasitic overshoot above the flat top of the pulse increases sharply. When the capacitance remains constant but the bandwidth of the stage widens, the stabilization time decreases and the magnitude of the overshoot increases. With constant values of capacitance and bandwidth, the overshoot is considerably larger in the case of band amplification of a radio pulse than in a resonance amplifier with a single output circuit. E.E.B.

N65-20341 Joint Publications Research Service, Washington, D. C.

CALCULATION OF THE TRAVELLING-WAVE TUBE EFFICIENCY BY THE SIMPLIFIED NON-LINEAR EQUATION

N. M. Sovetov *In its* Izv. VUZov: Radio Eng., Vol. 7, No. 5, 1964 5 Mar. 1965 p 138–141 refs (See N65-20326 10-10) CFSTI: $5.00

The mean efficiency of the travelling-wave tube was calculated and the accuracy of results indicated by graphs. It is shown that the representation of a field in the form of an exponentially increasing function in accordance with linear theory leads to accurate expressions for the efficiency and the saturation length as functions of tube parameters. E.E.B.

N65-20342 Joint Publications Research Service, Washington, D. C.

ON A CIRCUIT FOR COMBINED AMPLITUDE MODULATION

A. B. Chaplinskiy *In its* Izv. VUZov: Radio Eng., Vol. 7, No. 5, 1964 5 Mar. 1965 p 142–146 (See N65-20326 10-10) CFSTI: $5.00

The indices of performance for grid-modulated, plate-screen modulated, and plate-screan-grid modulated systems are compared. It is shown that with threefold modulation the oscillator efficiency is 1.5 times greater than with the grid modulation and is 25% less than with plate-screen modulation. The required modulator power, however, is reduced to one half as compared with plate-screen modulation. A circuit diagram of the modulator stage and the static characteristics of plate-screen modulation were plotted for various bias voltages, and it was found that rather effective threefold modulation can be obtained within the region of low screen voltages. It was concluded that threefold modulation systems can be designed efficiently for service-communication transmitters of low power. E.E.B.

N65-20343 Joint Publications Research Service, Washington, D. C.

ON THE THEORY OF MAGNETIC-TYPE RADIATION DEVICES WITH A POSITIVE COLD-CATHODE UNDER CYCLOTRON RESONANCE CONDITIONS

D. I. Trubetskov *In its* Izv. VUZov: Radio Eng., Vol. 7, No. 5, 1964 5 Mar. 1965 p 147–149 refs (See N65-20326 10-10) CFSTI: $5.00

A quantitative description of the processes taking place in magnetic-type radiation devices with positive cold-cathode under cyclotron resonance conditions is presented. The scatter equation is written which is similar to that for the M-type traveling wave tube and for the M-type reflex wave tube obtained by approximate adiabatic solution of the problem. The set of boundary conditions necessary for finding the amplitudes of the partial waves also correspond to those in the case of M-type traveling and reflex tubes. E.E.B.

N65-20344 Joint Publications Research Service, Washington, D. C.

A TRANSISTORIZED MODULE FOR SHAPING NANOSECOND PULSES

V. A. Chapala *In its* Izv. VUZov: Radio Eng., Vol. 7, No. 5, 1964 5 Mar. 1965 p 150–153 (See N65-20326 10-10) CFSTI: $5.00

The schematic diagram of a transistorized module designed for shaping nanosecond pulses in various printed circuits is presented. The voltage waveform in the circuit and oscillograms of the second stage pulse and output pulse are included. A

square pulse of 8-volts and 5-microseconds width is applied to the module input. As a result of this input, a pulse of 0.12-microseconds width is formed at the output of the first stage. The pulse width at the output of the second stage is 0.035 microseconds. The module delivers a pulse of 5-volts and 20-nanoseconds width to a load of 75 ohms with rise time of 3 nanoseconds. E.E.B.

N65-20345 Joint Publications Research Service, Washington, D. C.
ON THE APPROXIMATION OF THE VOLT–AMPERE CHARACTERISTICS OF TUNNEL-DIODES
A. C. Dmitriyev *In its* Izv. VUZov: Radio Eng., Vol. 7, No. 5, 1964 5 Mar. 1965 p 154–159 refs (See N65-20326 10-10) CFSTI: $5.00

It was determined that the theoretical approximations of voltage–ampere characteristics investigated were not suitable for the analysis of nonlinear distortions and gain instability of tunnel diode amplifiers, since an error of 2% in the determination of the negative resistance results in an error of 20% to 30% in determining the transfer ratio. The best approximation is one established empirically. Also, an approximation is given for calculation of transients in tunnel diode switching circuits. E.E.B.

N65-20477*# Bunker-Ramo Corp., Canoga Park, Calif.
ON THE INVERSE OPTIMAL CONTROL PROBLEM IN MANUAL CONTROL SYSTEMS
R. W. Obermayer and F. A. Muckler Washington, NASA, Apr. 1965 32 p refs
(Contract NASw-869)
(NASA-CR-208) CFSTI: HC $2.00/MF $0.50

Optimal control theory is briefly reviewed with particular emphasis on the inverse problem of finding the conditions under which a given system is optimum. A specific method for computing the optimal performance weighting coefficients is developed. While the data are inconclusive, application of this technique to some of the mathematical models of manual control systems existing in the literature reveals some intractability with theory, but with the suggestion that some observed trends in the data are consistent with a hypothesis of optimalizing human operator behavior. Some implications to manual control theory and experimental methodology are derived. Author

N65-20534# Litton Industries, San Carlos, Calif. Research Lab.
RESEARCH ON NOISE IN CROSSED-FIELD GUNS Quarterly Report, 1 Oct.–31 Dec. 1964
R. P. Wadhwa 20 Jan. 1965 52 p refs
(Contract NObsr-89546)
(QR-6; AD-612644)

Experimental data for a very low noise injected-beam crossed-field amplifier are given. Initially a noise-figure value of 3.5 with a small-signal gain of about 10 dB and saturated power output of 14 W was achieved. Under the best conditions a noise figure of 2.5 dB with a small-signal gain of about 10.5 dB and saturated power output of 18 W was achieved. The optimization of the various parameters in obtaining the low noise figure results is discussed. The dependence of the noise figure on the various parameters is investigated. The present low-noise amplifier has a noise transformer at the exit of the short Kino gun; the presence of this transformer also provides a good control on the beam optics and results in low-noise-figure values. The effect of mismatch at the output is investigated. The presence of ions does not add to any crossed-field interaction. However, the presence of ions can lead to poor optics, resulting eventually in a large noise content in the beam. Author

N65-20586 Joint Publications Research Service, Washington, D. C.
DISCUSSIONS ON TRANSLATION TERMS OF ELECTRONIC PRODUCTS IN VACUUM TUBE
In its Transl. on Communist China's Sci. and Technol., No. 162 23 Mar. 1965 p 29–30 Transl. into ENGLISH from Tien-tzu Chi-shu (Shanghai), Aug. 1964 p 47 (See N65-20582 10-34) CFSTI: $2.00

The problem of translation of electronic terms from English to Chinese is considered. The following standards are proposed: (1) Is the meaning exact? (2) Is the writing simple? (3) Is the sound clear? (4) Is the application appropriate? Emphasis is upon precision and clarity. Chinese terms for cathode, anode, plate, screen grid, and suppressor grid are given special attention. E.E.B.

N65-20614# Minneapolis-Honeywell Regulator Co., Minn. Aeronautical Div.
AN ADAPTIVE CONTROL SYSTEM FOR LARGE ELASTIC BOOSTERS
R. C. K. Lee and V. L. Falkner [1965] 55 p refs
(RSIC-U-64-49; MH-Misc-9)

The operation of a newly developed adaptive control system for elastic boosters is discussed. By providing automatic gain and phase compensation, the adaptive system greatly increases the system insensitivity to (1) bending frequency variations, (2) gyro pickup variations (variation in body modes shapes and slopes), (3) variation in aerodynamic parameters, and (4) variations of dynamic characteristics of compensation and associated hardware. This system uses the automatic gain-changing principle currently being flight tested in a supersonic fighter with excellent results. In addition, an automatic phase compensator stabilized crossover frequency and stability margin. The phase compensation is obtained by a proper logic of automatically blending the signals from two rate gyros located fore and aft of the first bending antinode of the missile. Extensive analytical and analog computer evaluation of this concept using a typical ICBM-type booster with bending frequency of 2 cps or lower shows extreme promise. Author

N65-20769# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ANALYSIS AND SYNTHESIS OF AUTOMATIC CONTROL SYSTEMS
Chih-Yieh Shu 8 Jan. 1965 117 p refs Transl. into ENGLISH from Shang Hai Shih K'o Hsueh Chi Shu Lun Wen Hsuan Chi, Kung Ch'eng Chi Shu (China), v. 1, 1962 p 283–359
(FTD-TT-62-24/1+2+3+4; AD-610288)

The theory and methodology for the analysis and synthesis of linear continuous control systems are presented. The principles and methods proposed are applicable to the single-variable systems of feedback control and regulation, and for the multivariable control systems of higher complexity. The problem of synthesis in control systems having several external loads is developed by the use of matrices. The concept of variable transfer sequence is derived by means of series. Also, the general rules governing decomposition of a response into forced and free components are investigated. Further, the calculation and assessment of the quality criteria for the responses of individual controlled variables are discussed. E.E.B.

N65-20771# Cornell Univ., Ithaca, N. Y. Electrical Engineering Research Lab.
ANALYTICAL TECHNIQUES FOR LINEAR TIME-VARYING SYSTEMS Technical Report No. 81
N. Liskov Nov. 1964 141 p refs
(Contract DA-36-039-AMC-00034(E))
(EERL-27; AD-609978)

The definition of several new system functions leads to a more complete characterization of time-varying linear systems. Methods are shown to be applicable to characterizing a satellite communication system and to correcting for delay and Doppler in an air-to-ground communications system and in a side-looking radar surveillance system. The matrix methods are applied to a feedback control system for a time-varying plant and to finding the system matrix of a whitening filter whose output is white stationary noise when the input is nonstationary noise with a given correlation. The matched filter for a channel with nonstationary noise is shown to consist of the whitening filter followed in cascade by a time-varying matched filter that is matched to the signal component of the output of the whitening filter. When the noise is slowly varying, the optimum transmitted signal is found. Author

N65-21118# University of Southern Calif., Los Angeles. Dept. of Electrical Engineering
INFRARED DETECTION WITH VARIATIONS IN CELL SENSITIVITY
D. P. Sullivan, I. S. Reed, and R. M. Gagliardi Nov. 1964 42 p refs
(Contract AF 04(695)-537)
(USCEE-119; SSD-TR-64-301; AD-454762)

An important method for detecting spatial targets is that of examining impinging infrared radiation upon a detector cell, and determining if the radiation originated from background alone or from a target immersed in background. In this report the optimum detection of infrared radiation is formulated, taking into account possible statistical variations of infrared cell sensitivity, as well as the statistics of the radiation and cell noise. The likelihood function at the cell output is constructed and the optimum processing is shown to depend upon these cell statistics. The feasibility of detector diversity (using more than one cell) is investigated, and shown to be successful in improving detection probabilities. Detailed results are given for the case of input radiation described by Poisson statistics. Author

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N65-20148# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.
THE SPACE SIMULATORS OF O.N.E.R.A. [LES SIMULATEURS D'ESPACE DE L'O.N.E.R.A.]
Jean Surugue and Marcell Le Mignon 1964 13 p In ENGLISH and FRENCH Presented at Symp. sur les Simulateurs d'Environement, London, 17 Nov. 1964
(ONERA-TP-175)

The space simulation facilities available at O.N.E.R.A. are described. These vacuum chambers, in which the pressure can reach 10^{-8} mbar or less, progressively evolved from studies requiring moderate altitude simulation. The first three vacuum tanks described are operational; the fourth, still under construction, will be 3 m in diameter and 5 m long to permit testing of large satellite components. In some parts of this chamber, it will be possible to use liquid helium at 4° K or infrared radiation at 500° K so that many factors of space simulation will be available at the same time. M.P.G.

N65-20193# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Porz (West Germany). Institut für Angewandte Gasdynamik
DEVELOPMENT AND ADJUSTMENT OF A GUN-TUNNEL FOR HYPERSONIC SPEEDS [ENTWICKLUNG UND JUSTIERUNG EINES STOSSWELLENWINDKANALS MIT FREIFLIEGENDEN KOLBEN FUR HYPERSONISCHE GESCHWINDIGKEITEN]
A. Heyser and W. Wyborny Dec. 1964 26 p refs In GERMAN; ENGLISH summary Sponsored by Deut. Forschungsgemeinschaft
(DVL-376; DLR-FB-64-34) Munich, ZLDI: 8.40 DM

Construction and working range of a gun tunnel for Mach 7 through 12 are described. First tests confirm the function of the tunnel. Author

N65-20196# Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (West Germany). Institut für Flugmechanik
ON A WATER ANALOGY INSTALLATION FOR THE INVESTIGATION OF MISSILES WITH SPEEDS OF Ma_∞ = 0,5–5,0 [UBER EINE WASSERANALOGIE-ANLAGE ZUR UNTERSUCHUNG VON FLUGKORPERN MIT GESCHWINDIGKEITEN ENTSPRECHEND Ma_∞ = 0,5 BIS 5,0]
G. Niehus Oct. 1964 38 p refs In GERMAN; ENGLISH and FRENCH summaries
(DLR-FB-64-49) Munich, ZLDI: 8.50 DM

The author reports on an installation for investigating gas dynamic problems at fast missiles by means of water analogy. The development of such an installation is difficult insofar as acceleration, surface stress, and friction are of complicated effect on the value interesting with respect to measuring technique. After a discussion of the constructive dependencies, an installation is described, as it has been built for the investigation of aerodynamic deceleration instruments in hypersonic- and supersonic ranges. Investigation- and evaluation techniques, as well as practical experience gained during operation of the installation are considered. Author

N65-20274 Joint Publications Research Service, Washington, D. C.
A COMPACT DEVICE FOR MAGNETIZING PERMANENT MAGNETS BY PULSED CURRENT
A. A. Preobrazhenskiy and R. D. Rabotnov *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 6, 1964 24 Mar. 1965 p 144–149 refs (See N65-20252 10-09) CFSTI: $5.00

The article describes a compact installation devised by the authors, for magnetizing permanent magnets. The device makes it possible to achieve a maximum pulsed current of 20 000 A, with a pulse duration of about 0.3 milliseconds. Some suggestions regarding the design of such a device, as well as test results, are given in the article. Author

N65-20282 Litton Systems, Inc., Beverly Hills, Calif. Space Sciences Lab.
A SINGLE-PHASE INDUCTION PLASMA ACCELERATOR
D. L. Curtis and A. S. Penfold 7 Dec. 1962 *In its* Res. on Electromagnetic Plasma Acceleration, Jun. 1964 35 p refs *Its* Publ.-2542 (See N65-20277 10-25)
(TM-62-46A)

A continuous wave polyphase-driven accelerator is detailed. The agreement between theoretical calculations and experimental measurements is better than expected, because the calculations were based on a simplified model and perturbing effects were omitted. However, they indicate that the measured values could not have been obtained without an extremely high percentage of ionization. The high degree of ionization is reasonable considering the excellent ionizing mechanism operating within the funnel. E.P.V.

N65-20323* National Aeronautics and Space Administration, Washington, D. C.
WHERE NEXT IN SPACE?
James E. Webb *In* George Washington Univ. The George Washington Univ. Mag. 1965 p 1-2 (See N65-20322 10-34)
CFSTI: HC $2.00/MF $0.50
(Grant NsG-425)

The Mariner IV spacecraft, and its 325-million-mile trip to Mars, is discussed. Also mentioned are the Surveyor and Lunar Orbiter projects for unmanned exploration of the moon; advances in weather and communications satellite technology; the Orbiting Observatory class of large sophisticated, unmanned scientific satellites; and the Gemini and Apollo manned space flight programs, which will take the first astronauts to the moon. Several new objectives for the years ahead are also identified. Exploration of Mars through the use of large unmanned soft-landing spacecraft and the scientific and technical missions in near-earth and synchronous orbits are discussed. Also under consideration are systematic lunar exploration, large orbiting space stations, and manned exploration of Mars. E.E.B.

N65-20428# AiResearch Mfg. Co., Los Angeles, Calif.
LIQUID CENTRIFUGE FEASIBILITY STUDY
G. T. Greene Nov. 1964 80 p refs
(Contract DA-18-064-AMC-242(A))
(CP-303; AD-610268)

A study is described in which the feasibility of separating and discharging from a liquid centrifuge 40- to 60-millimicron particles when introduced in a feed slurry of 5 to 8 gal per hr was determined. Continuous discharge of solids was demonstrated using a 4000-rpm, 1000-g flow visualization rig which consisted of a flat transparent rotor in which the flow patterns were observed with a stroboscopic light. Separation of yeast and various plastic particles in water suspensions were observed and discharge was achieved in three ways: (1) a continuous flowing carrier fluid having a density equal to that of the particles, (2) continuous flotation of the particles on top of an inert high-density fluid, and (3) semicontinuous by periodically filling the rotor with an inert high-density fluid which displaces and moves the particles to the center of the rotor. To demonstrate the mechanical integrity of the prototype suspension system, a 4.30-in diameter by 15-in long fiber glass rotor having a theoretical flow rate of 1.3 gal per hr was designed, fabricated, and tested to 51 000 rpm (165 000 g) with water flowing through the machine and tested to 54 500 rpm without liquid. Author

N65-20432 Douglas Aircraft Co., Inc., Santa Monica, Calif. Aerophysics Lab.
HYPERVELOCITY TECHNIQUES AND MEASUREMENTS
J. A. Copper, E. Akamine, F. J. Hameetman, H. R. Miller, and E. J. Ogostalick *In its* Results of Res. and Develop. Studies by the Douglas Aerophys. Lab. Staff During Fiscal Yr. 1963 Jan. 1964 23 p refs (See N65-20429 10-12)
(SM-43056-5)

A reliable, constant-volume-combustion process has been developed as a high-energy driver for a hypervelocity impulse tunnel. Other shock-tube topics are sequencing of the principal diaphragm burst, experimental investigation of steady driver-gas expansion at the principal diaphragm station, and phenomena associated with combustion at the hydrogen–air interface. A piezoelectric pressure transducer designed for low-pressure shock-tunnel measurements is described. A cold-wire probe has been applied to shock-tunnel diagnostic studies, and its use for boundary-layer studies is suggested. Preliminary experiments with equipment designed to measure optically the test section airflow velocity are reported. Author

N65-20433 Douglas Aircraft Co., Inc., Santa Monica, Calif. Aerophysics Lab.
STUDIES RELATED TO THE COMBINED FREE-FLIGHT SHOCK TUNNEL FACILITY
J. A. Copper and W. B. Covey *In its* Results of Res. and Develop. Studies by the Douglas Aerophys. Lab. Staff During Fiscal Yr. 1963 Jan. 1964 21 p refs (See N65-20429 10-12)
(SM-43056-6)

The counterflow facility derived by combining the light-gas gun and the shock tunnel should be capable of producing velocities in excess of 40 000 feet per second with corresponding flight Mach numbers. Problems, some operational but mainly related to instrumentation, make it difficult to obtain data in such a facility. However, in some instances, the flow conditions of interest cannot be produced in any other laboratory facility. The laboratory has both a light-gas gun and a shock tunnel. Studies aimed at generating interesting data in a counterflow facility incorporating them are described. The available performance envelope has been determined and experiments of interest that are consistent with available equipment have been analyzed. Work in progress on facility sequencing for concurrent operation and on several instrumentation techniques is reported. Author

N65-20434 Douglas Aircraft Co., Inc., Santa Monica, Calif. Aerophysics Lab.
EXPERIMENTAL INVESTIGATION OF AIR EJECTORS FOR THE TRISONIC FOUR-FOOT WIND TUNNEL
W. V. Speaker *In its* Results of Res. and Develop. Studies by the Douglas Aerophys. Lab. Staff during Fiscal Yr. 1963 Jan. 1964 20 p refs (See N65-20429 10-12)
(SM-43056-7)

In studies conducted in a 1/16-scale model of a trisonic 4-foot wind tunnel, two basic ejector types (annular and clustered) and seven mixing tube configurations were investigated. The tunnel was operated at Mach numbers between 3.1 and 4.7 both with and without a model in the test section. The ejector configuration chosen for the 4-foot tunnel will consist of four nozzles clustered downstream of the tunnel supersonic diffuser followed by a mixing tube with a constant section two diameters long and a contraction section with an area ratio of 0.8. A subsonic diffuser approximately one-quarter of the length of the existing diffuser will exhaust the flow into a perforated cylinder in the muffler tower which will help attenuate low-frequency vibrations. Starting and operating pressures in the modified tunnel with ejectors will be reduced by

a factor of three to four. Run durations will be at least 25 seconds with ejectors on, and ejector-off runs will be lengthened by about 50% due to the increased storage capacity and the reworked piping. For the same reasons, run times in the connected hypersonic two-foot wind tunnel will be increased as much as 140%. Author

N65-20435 Douglas Aircraft Co., Inc., Santa Monica, Calif. Aerophysics Lab.
TECHNIQUES FOR OBTAINING DYNAMIC DATA IN THE WIND TUNNEL
C. F. Christianson *In its* Results of Res. and Develop. Studies by the Douglas Aerophys. Lab. Staff during Fiscal Yr. 1963 Jan. 1964 13 p refs (See N65-20429 10-12)
(SM-43056-8)

Techniques for rigid body dynamic testing were investigated. The first step was a literature search to determine the state-of-the-art of techniques adaptable to the wind tunnels. Some 60 papers were reviewed and a bibliography was compiled of 33 of these sources. These sources indicate the latest trends in dynamic testing as the bulk of the information was published in the period 1958 to 1963. A body of knowledge is now assembled which will allow the application of rigid body dynamic testing techniques to stable or unstable configurations at Mach numbers 0.2 through 10. These techniques could be applied to the trisonic 1-foot, trisonic 4-foot or hypersonic 2-foot wind tunnels and, perhaps with more limited success, to the hypersonic impulse tunnel. Sting-mounted, transverse-rod-mounted and free-flight-model wind tunnel tests and their associated instrumentation and data reduction methods have been studied and development of the testing capability is now feasible. Author

N65-20544# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
WIND-TUNNEL BALANCE
V. N. Ovchinnikov, V. F. Zaytsev, and V. R. Bertyn' 8 Mar. 1965 6 p Transl. into ENGLISH from Soviet Patent No. 155641 (Appl. No. 788373/26-10, 24 Jul. 1962) 2 p
(FTD-TT-64-977/1+2; AD-612414)

A wind-tunnel balance is described which is purported to improve static sensitivity and determination of the dynamic components of a load placed on the balance. Vibration effects are reduced due to relatively low rigidity of the elastic measuring element. An accelerometric element in hinged suspension, consisting of a spring and two spring pickups with an electromagnetic converter, equalizes the dynamic loads on the movable system of the balance. Aerodynamic forces and dynamic factors are determined by simultaneous recording of signals in the electric circuits of both pickups. J.M.D.

N65-20546# Federal Aviation Agency, Washington, D. C. ATC Development Div.
THE NATIONAL AIRSPACE SYSTEM 1965: MAJOR FACILITIES, FUNCTIONS, MAINTENANCE COSTS Interim Report
Joseph D. Blatt Mar. 1965 249 p refs
(FAA-RD-65-25)

This report provides basic information concerning the National Airspace System including the type and number of facilities in the system, operational descriptions, equipment photographs, and annual maintenance costs. The purpose is to provide a reference document for use in the preparation of cost–benefit, cost comparison and cost effectiveness studies. Author

N65-20561# Academy of Technical Sciences, Copenhagen (Denmark)
INDEX OF ACHIEVEMENTS OF ATV 1962–63 [VIRKSOMHEDEN INDEN FOR ATV 1962–63]
[1963] 172 p in DANISH

The report describes the activities performed during 1962 and 1963 by the various laboratories, research institutes, societies, and associations which make up the Danish Academy of Technical Sciences. J.O.

N65-20606# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
CONSTRUCTION OF A SNOW RUNWAY AT CAMP CENTURY FOR WHEEL LANDINGS WITH LIGHTWEIGHT AIRCRAFT
Gunars Abele Aug. 1964 10 p refs
(CRREL-SR-62; AD-609981)

Brief descriptions of the required runway, the method of construction, the effort involved, and the suggested maintenance are given. An evaluation of the Rammsonde hardness instrument and its application in determining the supporting capacity of a snow runway is included. G.G.

N65-20633# Royal Aircraft Establishment, Farnborough (England).
TWO NEW FATIGUE MACHINES FOR TESTING REINFORCED PLASTICS
R. B. Heywood London, Min. of Aviation, Apr. 1961 23 p ref
(RAE-TN-CHEM-1380)

No entirely suitable equipment is available for testing reinforced plastics in fatigue, where requirements are characterized by the need for a low frequency of testing, the use of rectangular section specimens, and a constancy of load with changing strains in the specimen. This note summarizes attempts to meet the requirements by designing and developing two new machines intended specifically for testing reinforced plastics. One machine is of the resonance type and is capable of applying mean and alternating loads up to 1600 lb at a frequency of 400 cpm, and the other is of the 'brute force' type for the simultaneous testing of 20 specimens in four-point bending at a frequency in the range from 100 to 900 cpm. Author

N65-20701# Bendix Corp., South Bend, Ind. Analytical Mechanics Dept.
LUNAR LANDING DYNAMICS, SPECIFIC SYSTEMS ENGINEERING STUDIES Interim Report, Nov. 2, 1964–Feb. 10, 1965
R. G. Alderson et al 17 Feb. 1965 240 p refs Prepared for Bellcomm
(MM-65-2)

Studies were undertaken to derive dynamic analytical models of three soils by empirical procedures; to generalize these analytical models and associated computer subroutines into one comprehensive model; and to apply both the specific and general models to the prediction of stability and soil deformations during landings of a 1/10th dynamically scaled model. It was found that the footpad soil reactions during the landing impact operation are influenced strongly by the soil density, cohesive shear strength, and angle of internal friction. Computer simulation of real soil landings using an empirically derived quasi-state relationship for the footpad plowing force were found encouraging. Studies of the initial condition effects resulted in the design of a model launch facility for obtaining angular rate combinations at impact, checking of a 3-D landing dynamics computer program, and correlating its results with

previous experimental results. An approximate analysis methods study presents neutral stability results for simplified plastic, ideal elastic, and normal elastic models at rear pad impact, and for plastic models at front pad impact. G.G.

N65-20719# Los Alamos Scientific Lab., N. Mex.
CRYOGENIC TENSILE TESTING OF PROJECT ROVER MATERIALS
D. T. Eash 4 Mar. 1965 66 p refs
(Contract W-7405-ENG-36)
(LA-3161) CFSTI: $3.00

A tensile cryostat was developed with necessary adaptors to facilitate component testing of materials of interest at ambient, liquid nitrogen and liquid hydrogen temperatures. This report includes a detailed description of the cryostat and types of tests performed as well as data from testing of approximately 300 specimens. Author

N65-20721# California Univ., Berkeley. Lawrence Radiation Lab.
BEVATRON OPERATION AND DEVELOPMENT. 43, JULY THROUGH SEPTEMBER 1964
Robert W. Allison, Jr., Kenneth C. Crebbin, William L. Everette, and Emery Zajec 12 Feb. 1965 17 p ref
(Contract W-7405-ENG-48)
(UCRL-11935) CFSTI: $1.00

The Bevatron beam was on for 87.1% of the scheduled operating time. A loss in efficiency of injected-beam pickup was caused by a shorted turn in one of the inflector magnets. The external proton beam channel was extended to the third focus. Author

N65-20722# California Univ., Berkeley. Lawrence Radiation Lab.
BEVATRON EXPERIMENTAL AND EXTERNAL-PROTON-BEAM MAGNET POWER-SUPPLY SYSTEMS
Leslie T. Jackson 10 Feb. 1965 28 p refs
(Contract W-7405-ENG-48)
(UCRL-11952) CFSTI: $2.00

Magnet power-supply systems for both experimental and external-proton-beam (EPB) magnets are described as feedback control systems. Individual components contained in the systems are also described. The power-controlling component first used in the supplies was a three-phase magnetic amplifier. Silicon-controlled-rectifier (SCR) bridges are now being used. The requirements placed on the experimental magnet supply systems are $\pm 0.1\%$ current regulation with $\pm 10\%$ line-voltage perturbations occurring every pulse of the Bevatron. The EPB systems must track to at least $\pm 0.1\%$ a dynamic signal closely related to the proton beam energy. The performance criteria for EPB systems involve both error coefficients and transient response. Author

N65-20932# Lockheed Missiles and Space Co., Palo Alto, Calif. Materials Sciences Lab.
ELECTRICAL TRANSMISSION COMPONENTS FOR A LARGE AEROSPACE ENVIRONMENTAL CHAMBER
Francis J. Clauss Arnold AF Station, Tenn., Arnold Eng. Develop. Center, Feb. 1965 120 p refs
(Contract AF 40(600)-1000)
(AEDC-TR-65-40; AD-457356)

Secondary radiation in a large aerospace systems environmental chamber can be adequately simulated by an array of tungsten filament lamps mounted on a cage that surrounds the test vehicle. For conditions specified in this study, a total of 2528 lamps are required, arranged on 68 circuits (36 to 40 lamps per circuit) that are individually controlled for the purpose of simulating orbital fluctuations. Peak input to each of the circuits is approximately 75 A at 430 V, and peak total input is 0.818 MW. The simulator should be mounted so that it can tumble with the vehicle about the vehicle's pitch axis. Variations in intensity of secondary radiation around the circumference of the vehicle can be programed electrically so that the simulator need not rotate about the roll axis of the test vehicle. Sliding electrical contacts are preferred to flexible cables or rotary transformers for transmitting power to the simulator, and separate slip rings can be provided for each of the circuits. Self-lubricating powder metallurgy composites of silver, copper, and molybdenum disulfide have demonstrated satisfactory performance in ultrahigh vacuum for use on slip rings providing power to the secondary radiation simulator. Optimum composition is from 82.5% to 85% silver, 2.5% copper, and 12.5% to 15% molybdenum disulfide. Author

N65-20934# ARO, Inc., Arnold Air Force Station, Tenn.
EXPERIMENTAL PROJECTILE KINEMATIC STUDIES IN A TWO-STAGE LIGHT-GAS GUN
R. E. Knapp and R. E. Hendrix Arnold Eng. Develop. Center, Mar. 1965 32 p refs
(Contract AF 40(600)-1000)
(AEDC-TR-65-60; AD-459347)

A microwave reflectometer was used to study projectile kinematics in a small, shock-compression, two-stage, light-gas gun. Measurements were made at launch velocities from 8000 (2.44 km/sec) to 21 000 ft/sec (6.40 km/sec), and time–distance histories having $\pm 5\%$ accuracy were obtained. Velocity and acceleration data were evolved from these time–distance histories. For the test conditions, maximum projectile acceleration was seen to occur at the start of projectile travel for shots at muzzle velocities up to 14 000 ft/sec (4.27 km/sec). At this muzzle velocity, and with projectile retention maintained until the arrival of the second shock wave at the projectile base, a peak acceleration of 12.9×10^6 g was realized. This acceleration figure was not exceeded, even during a shot which produced a muzzle velocity of 21 000 ft/sec (6.40 km/sec). The location in the launcher barrel at which peak acceleration occurs varies with minor adjustments in projectile retention and launcher cycle. Absorption and reflection of the microwave signal from the plasma between the projectile and its bow shock wave are seen as the greatest shortcoming of the reflectometer technique. Author

N65-20936# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Aerospace Engineering and Applied Mechanics
THE COMBUSTION DRIVEN SHOCK TUNNEL OF THE POLYTECHNIC INSTITUTE OF BROOKLYN
Marian Visich, Jr., Samuel Lederman, and Wing H. Mak Jan. 1965 65 p refs
(Contract Nonr-839(25))
(PIBAL-847; AD-459043)

A hypersonic shock tunnel was designed and constructed for obtaining fluid dynamic and electromagnetic properties of the flow field around hypersonic reentry bodies. The design philosophy and a description of the combustion driven shock tunnel is presented, as well as the estimated performance over a range of test section stagnation conditions. Author

N65-20957# Naval Radiological Defense Lab., San Francisco, Calif.
NON-INGESTED DOSE ASSOCIATED WITH PARTICULATE INGRESS INTO A PROTOTYPE SHELTER VIA THE VENTILATION SYSTEM

M. M. Bigger, R. J. Crew, R. K. Fuller 20 Jan. 1965 39 p refs (USNRDL-TR-815; AD-459461)

Particulate penetration into the experimental shelter via the ventilation system operating without filters was determined as a function of particle size. Relatively good agreement was found with the small amount of applicable Shot Small Boy data. Estimates of the dose within a shelter due to particulate penetration and deposit (ingress dose) were made using values of fallout model parameters for weapon yields of 100 to 100 000 kt (assuming 100% fission). Ingress doses are presented as a function of particle size and downwind distance so that the particle sizes of importance may be determined for any given acceptable ingress dose. Author

N65-20967# Midwestern Universities Research Association, Madison, Wis.

MINUTES OF THE 1964 CONFERENCE ON PROTON LINEAR ACCELERATORS HELD AT MIDWESTERN UNIVERSITIES RESEARCH ASSOCIATION, JULY 20–24, 1964

F. E. Mills, C. D. Curtis, D. A. Swenson, and D. E. Young [1964] 640 p refs Sponsored by AEC
(UC-28) CFSTI: $9.42

Progress made in the design of proton linear accelerators was discussed. Among the topics covered were the following: *R.F. Accelerating Structures: The Cross-Bar Structure; Coupled Resonator Model of Linear Accelerator Tanks; 800 MeV RF Structures; Characteristics of Slotted Irises; Fabrication and Measuring Methods for Disk-Loaded Waveguides; Study for Superconducting Multi-GeV Proton Linac, Drift Tube and Parameter Selection for Linear Accelerator Structures Below 150 MeV; Dynamic Effects of Higher RF Harmonics; Beam Dynamics Calculations for Alvarez-Type Linear Accelerators; Application of Calculated Fields to the Study of Particle Dynamics; A New Approach to Preinjectors;* and *A Family of Improved Linac Bunchers.* G.G.

N65-20970# Oklahoma State Univ., Stillwater. Fluid Power and Controls Lab.

STUDY OF FILTRATION MECHANICS AND SAMPLING TECHNIQUES Technical Summary Report, 1 Sep. 1963–30 Nov. 1964

Robert E. Reed, Roger H. Tucker, and Kirby Stone 30 Nov. 1964 119 p refs
(Contract NAS8-11009)
(NASA-CR-57778) CFSTI: HC $4.00/MF $0.75

A basic theoretical and experimental approach was initiated in filtration mechanics to determine the importance of physical parameters to filter performance. Methods of measuring the physical parameters of wire cloth media, which are contained in theoretical relationships between fluid flow through a medium and the corresponding pressure drop across the medium, were investigated. Assumptions are made for using relationships for laminar flow through wire cloth media, and it is shown that the assumptions are valid for the case. Many of the important aspects of sampling the fluid of dynamic hydraulic systems of the high performance fluid power and control types are covered. Practical considerations for extracting and analyzing a fluid sample for its particulate contamination content are described or otherwise defined. Theoretical considerations to establish a basis for sampling techniques are discussed. Comprehensive data from isokinetic sampling of a laminar flow test section are included. Also, it is shown how an isokinetic test section can be utilized in the evaluation of commercially available sample valves under specific conditions. Author

N65-21001*# National Aeronautics and Space Administration, Washington, D. C.

THE GERMAN GROUND STATION FOR INTERCONTINENTAL SATELLITE COMMUNICATIONS [DIE DEUTSCHE ERDEFUNKSTELLE FUR DEN INTERNATIONALEN SATELLITEN-NACHRICHTENVERKEHR]

Ernst Dietrich Apr. 1965 49 p refs Transl. into ENGLISH from Jahrb. Elek. Fernmeldewesens (Windsheim), 1964 p 265–312
(NASA-TT-F-9308) CFSTI: HC $2.00/MF $0.50

A Government owned and operated ground station for radio, television, facsimile, and multichannel telephone transmission over the communications satellites Telstar and Relay, as part of a NASA program, is described. The station works with a broadband and a narrowband installation, the latter being a mobile unit manufactured by International Telephone and Telegraph Corporation. The basic principles of both systems are described, with special emphasis on the 25-m Cassegrain antenna with parabolic horn feed, unique in design. Layout, technical data, monitoring equipment, and design features are tabulated, plotted, and shown in photographs. Author

N65-21010# Hughes Aircraft Co., Fullerton, Calif. Ground Systems Group

STUDY OF SIMULATION TECHNIQUES FOR LABORATORY SIMULATION OF NUCLEAR RADIATION ENVIRONMENTS Final Report, 1 Dec. 1963–30 Nov. 1964

K. G. Kerris [1964] 36 p refs
(Contract Nonr-4359(00))
(FR-64-10-317; AD-609057)

The feasibility of a 15-MeV, 1000-ampere electron storage ring is demonstrated. All the important beam loss mechanisms are treated, including space charge and coherent and incoherent image force effects. The problem of imperfection and coupling resonances is discussed. The analytical work led to the design of a 1/4-scale-model magnet. The results of magnetic field mapping in this magnet are presented. Finally, a preliminary storage ring design which is considered acceptable is discussed. Author

N65-21017# Princeton Univ., N. J. Aerospace and Mechanical Sciences Dept.

PRELIMINARY DESIGN CONSIDERATIONS FOR A V/STOL WIND TUNNEL Final Report, 1 Jul. 1963–31 Aug. 1964

Marcus P. Knowlton Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Jan. 1965 38 p refs
(Contract AF 33(657)-12174)
(FDL-TDR-64-146; AD-612906)

This report describes a tandem test section low speed wind tunnel and the attributes and design considerations of using either an open return or closed return. Power and cost estimates are made. Author

N65-21093# Argonne National Lab., Ill.

A LARGE, HIGH-FIELD, SUPERCONDUCTING MAGNET SYSTEM

C. Laverick and G. M. Lobell Jan. 1965 17 p refs
(Contract W-31-109-ENG-38)
(ANL-7002) CFSTI: $1.00

A superconducting magnet system composed of three separate, easily removable, nested solenoids is described. The outer two solenoids are split-coil systems so that particle beams can be directed through the magnet when these sections are used to provide the magnetic field for a helium bubble chamber. Magnetic fields of 67, 42, and 17 kG have

been achieved in winding diameters of 7, 11, and 18 in., respectively. The results indicate that the system is capable of operation at fields in excess of 70 kG. The magnet is wound from various types of superconducting cable. Some of the considerations governing the choice of cable types and magnet design are presented. The tests carried out on the magnet system are described, and the test results discussed. Author

N65-21108# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HIGH TEMPERATURE ARRANGEMENT FOR TESTING LONG LASTING STRENGTH AND CORROSION STABILITY OF STRUCTURAL MATERIALS IN LIQUID SODIUM
V. I. Nikitin 14 Jan. 1965 11 p refs Transl. into ENGLISH from Teploenerg. (Moscow), no. 5, 1963 p 80–83
(FTD-TT-64-704/1+2; AD-610299)

In this report are described structural features of a lab arrangement for testing corrosion resistance and strength of structural materials in a sodium stream at a temperature of up to 1000° C. Given are results of brief corrosion testing of nickel base alloys and chromium nickel austenitic steel at 1000° C. Author

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N65-20297# Joint Publications Research Service, Washington, D. C.
HYDROACOUSTICS
A. Prostakov 1 Apr. 1965 6 p Transl. into ENGLISH from Voyennyye Znaniya (Moscow), no. 1, Jan. 1965 p 36–37
(JPRS-29389; TT-65-30630) CFSTI: $1.00

The increasing role of hydroacoustic apparatus in ships and submarines for underwater observation, navigation, and communications is discussed. Several hydroacoustic devices, each with a particular function, are described in detail and include bearing indicators, hydrolocators, radiohydroacoustic buoys, and echo sounders. R.N.A.

N65-20301# Birmingham Univ. (England). Dept. of Mechanical Engineering
THE THEORETICAL AND EXPERIMENTAL ANALYSIS OF THE TANDEM AXIAL-FLOW BLADE ROW Final Technical Status Report, 1 Jul. 1961–30 Jun. 1964
[1964] 90 p refs
(Contract DA-91-591-EUC-3009)
(AD-455111)

Studies of flow in tandem cascades are presented. Tandem cascades were investigated in rheoelectrical analogy devices and in a cascade wind tunnel. A blower with tandem cascade blades was evaluated. An experimental investigation of wake-boundary layer interaction is reported. A theoretical design treatment of cascades by the singularity method, and by conformal transformation from the hodograph plane, is presented. Theoretical calculations on the pressure distribution around a pair of tandem cascade blades are discussed. J.M.D.

N65-20424*# Lockheed Missiles and Space Co., Huntsville, Ala.
A REVIEW OF SELECTED METHODS OF PREDICTING BASE FLOW ENVIRONMENT IN SUPERSONIC FLOW
T. O. Ying Jul. 1964 33 p refs
(Contract NAS8-11148)
(NASA-CR-57616; H-64-008; LMSC/HREC-A036435)
CFSTI: HC $2.00/MF $0.50

Methods for predicting the base flow environment in supersonic flow were reviewed; only those methods analytical in approach were selected for discussion. The merits and the limitations of each selected method are discussed. In some cases, means of improvement are suggested. Of the methods, primary emphasis was placed on the two-dimensional turbulent wake methods of Korst, et al and Nash and the axisymmetric turbulent wake method of Zumwalt. Less emphasis is placed on the laminar theory of Chapman, et al. Discussed briefly is the semiempirical turbulent wake method of Love, and the combination of Chapman's equivalent-cylinder flow-turning method with Zumwalt's method for predicting base pressures on cones and boattails. Author

N65-20429# Douglas Aircraft Co., Inc., Santa Monica, Calif. Aerophysics Lab.
RESULTS OF RESEARCH AND DEVELOPMENT STUDIES BY THE DOUGLAS AEROPHYSICS LABORATORY STAFF DURING FISCAL YEAR 1963
W. E. Smith, ed. Jan. 1964 236 p refs
(SM-43056)

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N65-20431 Douglas Aircraft Co., Inc., Santa Monica, Calif. Aerophysics Lab.
OPTICAL FLOW VISUALIZATION
W. A. Stolzenburg *In its* Results of Res. and Develop. Studies by the Douglas Aerophys. Lab. Staff during Fiscal Yr. 1963 Jan. 1964 25 p refs (See N65-20429 10-12)
(SM-43056-3)

This report records the progress of flow visualization experiments in intermittent wind tunnels. Investigations were made in the fields of quantitative color Schlieren, glow discharge

visualization, Schlieren interferometry and colored oil flow visualization. The experiments were conducted to investigate the applicability of extending these techniques to the increasingly sophisticated areas of aerodynamic testing now required. The report also discusses the theory of optical flow visualization in general and Schlieren systems in particular. The results of the quantitative color Schlieren investigations indicated that the technique is feasible. The glow visualization technique was successfully demonstrated at Mach 11 in the hypervelocity impulse tunnel. An improvement in the Schlieren technique over the conventional Schlieren was exhibited both in sensitivity and interpretation. Author

N65-20436 Douglas Aircraft Co., Inc., Santa Monica, Calif. Aerophysics Lab.
BOUNDARY LAYER TRANSITION AT HYPERSONIC SPEEDS
R. E. Deem *In its* Results of Res. and Develop. Studies by the Douglas Aerophys. Lab. Staff during Fiscal Yr. 1963 Jan. 1964 9 p refs (See N65-20429 10-12)
(Contract AF 33(657)-10660)
(SM-43056-9)

An analytical and experimental investigation of flat plate boundary-layer transition at hypersonic speeds is described. The investigation was initiated with a literature survey and publication of a bibliography. Several significant findings of previous transition investigations are given. Development of the model design specifications and test procedures are described; these are based on the test requirements to obtain transition and boundary layer data over a range of unit Reynolds numbers, sweep angles, wall-to-adiabatic-wall temperature ratios, and Mach numbers for two values of leading edge bluntness. A method is described whereby the transition data will be correlated by an analytic expression including all five variables. Author

N65-20437 Douglas Aircraft Co., Inc., Santa Monica, Calif. Aerophysics Lab.
TURBULENT BOUNDARY LAYER NOISE
W. V. Speaker *In its* Results of Res., and Develop. Studies by the Douglas Aerophys. Lab. Staff during Fiscal Yr. 1963 Jan. 1964 16 p refs (See N65-20429 10-12)
(SM-43056-10)

Static and fluctuating pressure measurements were made on the sidewall of a wind tunnel from Mach 0.43 to 3.46 in the presence of a turbulent boundary layer. Effects of Mach number are found to be small but, when the flow is perturbed by shock waves, by pressure gradients, or by local roughness, increases in the fluctuating pressure levels on the order of 20 times that of the clear tunnel case have been recorded. Author

N65-20438# Heliodyne Corp., Los Angeles, Calif.
MIXING AND FLUCTUATIONS IN A TURBULENT WAKE
Andrew P. Proudian Dec. 1964 41 p refs
(Contract DA-04-495-AMC-458(Z); ARPA Order 360; Proj. Defender)
(RR-8; AD-610096)

The structure of turbulent wakes of hypersonic bodies is argued to be largely controlled by the combined action of relatively large-scale random convective motions, which introduce inhomogeneities in the wake core, and of molecular diffusion aided by turbulent distortions of fluid elements. A previously developed mathematical model representing turbulent wake mixing in terms of a mixing lag is discussed. Numerical predictions for the magnitude and variation of mass density fluctuations in a relatively low speed wake are obtained by solving a simplified set of equations, in which the lag is represented by an effective mixing boundary, and are in encouraging agreement with the general magnitude and trend observed experimentally. Author

N65-20486*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
A PERFECT-GAS ANALYSIS OF THE EXPANSION TUNNEL, A MODIFICATION TO THE EXPANSION TUBE
Robert L. Trimpi and Linwood B. Callis Washington, NASA, Apr. 1965 104 p refs
(NASA-TR-R-223) CFSTI: HC $4.00/MF $0.75

A perfect-gas analysis is presented for an apparatus consisting of a basic expansion tube at the downstream end of which is a nozzle. The resultant apparatus, named the expansion tunnel, is shown to have the following advantages when compared with the basic expansion tube: increased testing time, larger initial test-gas slug length, higher efficiency, and reduced secondary-diaphragm bursting problems. Principal disadvantages are requirement of an additional nozzle, and the requirement of a larger ratio between maximum and minimum pressures in an operating cycle. Author

N65-20492# Royal Aircraft Establishment, Farnborough (England).
LOW SPEED FLOW STUDIES OF THE VORTEX PATTERNS ABOVE INCLINED SLENDER BODIES USING A NEW SMOKE TECHNIQUE
R. L. Maltby and D. H. Peckham London, Min. of Supply, Nov. 1956 14 p refs Addendum added Mar. 1957
(RAE-TN-AERO-2482)

A simple method of making visible the vortex flow pattern above an inclined body in a low-speed tunnel is described. Examples of such flow are given, and two main types of vortex pattern are identified at high incidence. Author

N65-20501# Royal Aircraft Establishment, Farnborough (England).
SURVEY OF INVISCID HYPERSONIC FLOW THEORY FOR GEOMETRICALLY SLENDER SHAPES
L. F. Crabtree London, Min. of Aviation, Jun. 1960 28 p refs
(RAE-TN-AERO-2695)

A survey is made of existing theories for the calculation of pressure distributions on slender bodies at hypersonic speeds. No account is taken of boundary layer displacement effects. The breakdown of linearized supersonic theory is demonstrated as Mach number increases above about 5; a derivation of the hypersonic similarity rule is given. A physical interpretation of hypersonic flow is outlined, and a simple derivation of the modified Newtonian pressure formula given. The equations of flow through an oblique shock wave are simplified by assuming a strong shock, and various results are thereby derived. A description of the Newtonian approximation for slender bodies, includes the effect of centrifugal forces, and the connection with Newtonian flow theory is emphasized for $\gamma \to 1$. The shock expansion method is described for both two- and three-dimensional bodies; some remarks are made about the available data sheets and tables for estimating pressures on cones and ogive-cylinders in yaw. Author

N65-20502# Royal Aircraft Establishment, Bedford (England).
AN EXPERIMENTAL STUDY OF THE GLANCING INTERACTION BETWEEN A SHOCK WAVE AND A TURBULENT BOUNDARY LAYER

A. Stanbrook London, Min. of Aviation, Jul. 1960 24 p refs
(RAE-TN-AERO-2701)

An experimental study was made at Mach 1.6 to 2.0 of the interaction between the turbulent boundary layer on a side wall of a wind tunnel and the shock wave produced by a plate mounted on the wall. Under these conditions the shock wave–boundary layer interaction was three-dimensional at least over the region investigated (up to 10 boundary-layer thicknesses from the plate). The boundary layer was separated by a shock wave of strength $p_2/p_1 \div 1.5$ i.e., a flow deflection between 7.5° and 8°. Interactions of this type occur on the sides of fuselages at the wing–fuselage junction and may therefore be important with regard to the design of waisted shapes. Author

N65-20504# Royal Aircraft Establishment, Bedford (England).
FLOW VISUALIZATION IN LOW-SPEED WIND TUNNELS: CURRENT BRITISH PRACTICE
R. L. Maltby and R. F. A. Keating London, Min. of Aviation, Aug. 1960 40 p refs
(RAE-TN-AERO-2715)

Current methods of flow visualization in low-speed wind tunnels, including smoke and surface flow techniques, are described. Author

N65-20506# Royal Aircraft Establishment, Farnborough (England).
SIMPLE THEORETICAL AND EXPERIMENTAL STUDIES OF THE FLOW THROUGH A THREE-SHOCK SYSTEM IN A CORNER
E. Eminton London, Min. of Aviation, Sep. 1961 22 p refs
(RAE-TN-AERO-2784)

To find the three-shock system in a given corner appropriate to flow at a given Mach number a simple theoretical model is considered. It assumes straight shocks and streamlines, and concentrates on the flow in the region of the point where the main shock branches into two. A shear layer originates there and imposed conditions match both pressures and flow directions on either side of it. Theory and experiment lead to the conclusion that the shock system in a corner is determined not by the way the flow behaves around the branch point but by its behavior around the feet of the branches which lie within the boundary layer. Thus viscous effects dominate the flow field and the external inviscid part of the flow appears able to accommodate itself readily by small deviations from the simplified model considered. Author

N65-20507# Royal Aircraft Establishment, Bedford (England).
WIND TUNNEL CALIBRATION OF INCIDENCE VANES FOR USE ON THE FAIREY E. R. 103
F. W. Dee and D. G. Mabey London, Min. of Aviation, Sep. 1961 16 p refs
(RAE-TN-AERO-2785)

A cruciform arrangement of vanes for the measurement of angles of incidence and sideslip was calibrated in a wind tunnel, to determine the errors in the angular indications of the vanes due to manufacturing imperfections, and also the sensitivity of the vanes over their angular range. The results indicate that errors due to imperfections vary between 0.1° and 0.3° over a Mach number range of 0.8 to 1.6, while the vane sensitivity (in terms of the ratio of the indicated to the true incidence) is about 1.06 at M = 0.8, rising to 1.14 at M = 1.6. Author

N65-20509# Royal Aircraft Establishment, Farnborough (England).
CALCULATIONS OF THE STRUCTURE OF UNSTEADY RAREFACTION WAVES IN OXYGEN/ARGON MIXTURES, ALLOWING FOR VIBRATIONAL RELAXATION
J. P. Appleton London, Min. of Aviation, Feb. 1963 33 p refs
(RAE-TN-AERO-2873)

Numerical computations were performed to investigate the effect of molecular vibrational relaxation on the structure of one-dimensional unsteady rarefaction waves in oxygen and oxygen–argon mixtures. A nonequilibrium flow feature illustrated by the results of the relocation equation is that the vibrational temperature of gas which enters an aging wave will first decrease, closely following the translational temperature, until at some position within the wave it will depart rapidly from the translational temperature and eventually freeze at a constant value. Author

N65-20516# Royal Aircraft Establishment, Farnborough (England).
A BRIEF NOTE ON PERIODIC DISTURBANCES IN A LAMINAR SHEAR LAYER
D. Pierce London, Min. of Aviation, Jun. 1964 11 p refs
(RAE-TN-AERO-2970)

Earlier experiments on the formation and growth of vortex sheets behind plates accelerated from rest are extended in two respects to provide further information about the disturbances observed in the shear layer. It is inferred from an approximate calculation of the relative displacement of dyelines in the field of a row of discrete vortexes that the observed concentrations of injected particles along the shear layer are indeed genuine concentrations of vorticity. The shedding frequency of this small-scale vorticity is determined and a characteristic Strouhal number is found. Author

N65-20543# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON UNIFORMLY ACCELERATED MOTION OF FLAT PLATE IN VISCOUS COMPRESSIBLE GAS
V. V. Sychev and N. S. Avanesova 12 Feb. 1965 15 p refs
Transl. into ENGLISH from Zh. Vychislitel'noi Mat. i Mat. Fiz. (Moscow), v. 3, no. 6, 1963 p 1067–1076
(FTD-MT-64-541; AD-612372)

System of differential equations describing flow of gas under action of a plate with infinite dimensions is given. A method of numerical solution of the equations was developed and applied to the problem of flow near thermally insulated and cold flat plates. Based on calculations for this problem, data are presented on viscosity, pressure, density, and formation of shock waves near the plate. J.M.D.

N65-20638# National Gas Turbine Establishment, Pyestock (England).
SOME EXPERIMENTS ON THE MEASUREMENT OF AIR FLOW BY TRAVERSING A DUCT
H. A. Knight London, Min. of Supply, Nov. 1953 53 p refs
(NGTE-M-178)

Various experiments undertaken to obtain a reliable aerodynamic calibrating technique in a measuring duct are summarized. The final result was only partly successful and the method has been postponed while an alternative is tried. The tests resulted from attempts to reduce errors as they are discovered, not as a planned experiment. The principal source of inaccuracy with the original method was the static pressure variation across the measuring plane. This variation was not

removed although it was reduced to a minimum by correcting the static wall taps and removing swirl generated by a gate valve upstream of a radius bend. An airflow meter calibrated by the section in its original form (total pressure traverse only) would have an error of at least 1 1/4%. The accuracy of the calibrating section with modified traversing gear is comparable with a B.S. orifice plate. Probable causes for the static pressure variation are given, and features of the experiments which are applicable to general flow measurements are listed. Author

N65-20656# National Gas Turbine Establishment, Pyestock (England).
THE CALCULATION OF THE DISCHARGE COEFFICIENT OF PROFILED CHOKED NOZZLES AND THE OPTIMUM PROFILE FOR ABSOLUTE MASS FLOW MEASUREMENT
B. S. Stratford London, Min. of Aviation, Jun. 1962 28 p refs
(NGTE-M-357)

A choked nozzle with an appropriate wall contour has a discharge coefficient, C_D so close to unity that a theoretical calculation of $(1 - C_D)$ would allow the nozzle to be used as an absolute meter for airflow. Simplified calculations yield formulas for the boundary-layer dislacement thickness and for the flow reduction resulting from the variation in static pressure across the throat. The optimum profile for the wall at the throat of an absolute meter is suggested to be a circular arc of radius of curvature equal to about twice the throat diameter. For such a meter the theoretical discharge coefficient is found to be within a 1/4% of 0.995 over a wide range of Reynolds numbers. Author

N65-20660# Royal Aircraft Establishment, Farnborough (England).
A NUMERICAL METHOD FOR CALCULATING INVISCID VORTEX CORES
M. R. Abbott and M. G. Hall London, Min. of Aviation, May 1962 22 p
(RAE-TN-MATH-81)

A numerical method is presented for solving the equations of motion for axially symmetric flows of an incompressible, inviscid but rotational fluid. The method of solution is to replace derivatives in the axial direction by finite differences and then to solve the resulting set of ordinary nonlinear differential equations by the Runge–Kutta method. Appropriate boundary conditions are given at some upstream cross section and on some outer boundary surface. Along the axis of symmetry the condition of zero radial velocity is imposed. Difficulties associated with stability and with the two-point boundary conditions for the ordinary nonlinear differential equations are described, and a sample calculation is presented. Author

N65-20676# Royal Aircraft Establishment, Farnborough (England).
THE BOUNDARY LAYER ON A TOWNEND SURFACE
J. C. Cooke and O. K. Jones London, Min. of Aviation, Feb. 1964 31 p refs
(RAE-AERO-2687)

Certain three-dimensional surfaces studied by Townend have the property that at every streamwise section a supersonic airstream is compressed isentropically in the form of a reversed Prandtl–Meyer flow. If all the compressions are centered on points lying on one straight line, the flow is conical. Such a surface may be of use as an engine intake. An approximate boundary-layer calculation for such a surface is made for laminar flow with zero heat transfer in the conical case. Under certain circumstances a useful amount of compression can be obtained before separation occurs (a pressure ratio of 6 for instance for an initial Mach number of 10). Limiting streamlines are drawn and displacement thickness is calculated for a typical case, and the Mach number at separation is determined for a range of initial Mach numbers and angles-of-sweep. Instability due to sweep is considered. Author

N65-20730# Boeing Co., Seattle, Wash.
NON-SIMILAR BOUNDARY LAYER—REAL GAS COMPUTER PROGRAM
C. Jaeck and W. Jackson [1964] 375 p refs
(Contract AF 33(615)-1791)
(D2-81296; AD-446581)

The nonsimilar boundary layer program is described and instructions for its use are provided. Detailed calculation of laminar boundary layer characteristics for either stagnation or nonstagnation flow, including three-dimensional effects and mass injection is included. A brief description of the numerical method is given followed by a detailed description of the equations and calculations. Numerical instability of the boundary layer equation is discussed, and stability relationships are presented. A sample case is included to illustrate input–output display. Flow charts and program listings are also given. The program is written in the Fortran II and FAP languages for the IBM 7094 digital computer. Author

N65-20738# Royal Aircraft Establishment, Farnborough (England).
THE MEASUREMENT OF DYNAMIC GAS PRESSURES
K. R. Maslen London, Min. of Aviation, Jun. 1964 35 p refs
(RAE-TN-MECH-ENG-402)

Dynamic measurement of gas pressures is discussed with particular reference to the pneumatic response of pressure transducers. The effects of asymmetry of transducers measuring gas flow, and of pressure amplitude and ambient pressure on pneumatic damping are considered. Electric analogs of pressure transducers and associated piping are given. Methods of dynamic calibration are described. Author

N65-20816# ARO, Inc., Arnold Air Force Station, Tenn.
BOUNDARY SIMULATION PARAMETERS FOR UNDEREXPANDED JETS IN A QUIESCENT ATMOSPHERE
M. Pindzola Arnold Eng. Develop. Center, Jan. 1965 26 p refs
(Contract AF 40(600)-1000)
(AEDC-TR-65-6; AD-454770)

A summary of some of the parameters now in use to obtain jet boundary simulation in a quiescent atmosphere is presented. The shortcomings of these parameters are depicted by showing jet boundaries calculated to an axial distance of 10 nozzle exit radii by an approximate technique. Using this approximate technique as a basis for evaluation, a new parameter is presented which, when used in conjunction with the initial inclination angle of the jet, provides a means of specifying jet operating parameters for the simulation of jet boundaries. Methods for preselecting model jet operating and geometric conditions are also discussed. Author

N65-20819 California Univ., Santa Barbara. Physics Dept.
POPULATION INVERSIONS IN THE $B^2\Sigma$ STATE OF N_2^+
J. L. Dunn *In its* Quant. Studies by Opt. Spectry. of Energy Exchange Mech. in Simple Gases and Solids 1 Jan. 1965 p 12–14 refs (See N65-20817 10-23)

A detailed perturbation calculation on the mutual interaction between the v = 1 level of the $B^2\Sigma$ state and the v = 11

level of the $A^2\pi$ state of N_2^+ is nearly completed. Data on the magnitude of the level separations are available for use in the perturbation calculations which will allow calculation of the microwave transition probabilities. Author

N65-20858# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SECOND SECTION OF GROUND EXPERIMENTS WITH WEIGHTLESS LIQUIDS
V. V. Shuleykin 4 Jan. 1965 9 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 153, no. 6, 1963 p 1299–1302
(FTD-TT-64-613/1+2; AD-610294)

Behavior of mercury, and of bidistilled water and bromobenzene, in vacuum is described. The liquids were placed at the bottom of a fluoroplast drain ditch with a spherical surface at the top, and motion pictures were made as the liquid rose during the vacuum period. Oscillations of the body of rotation were studied in the photographs. In the mercury experiment it was concluded that surface energy losses due to marginal-angle hysteresis were low. In the water and bromobenzene experiment major drop in the period of oscillation was due to hysteresis, but due even more to energy appearing on the water-fluoroplast surface. J.M.D.

N65-20860# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON NONLINEAR THEORY OF ORIGINATION OF TURBULENCE
E. M. Khazen 12 Jan. 1965 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 153, no. 6, 1963 p 1284–1287
(FTD-TT-64-698/1 + 2; AD-610298)

A closed system of equations for the average flow velocity and spectral tensor of turbulent pulsations was introduced to describe the initial stage of turbulence originating in viscous incompressible flow. The system of equations for velocity corresponds to the linear approximation in Navier–Stokes equations, obtained by discarding the third moments which are small at the beginning. At low turbulence level the fourth moments are expressed through the second ones in accordance with the Gaussian law. With rise in pulsation amplitude, the distribution law may be non-Gaussian. The numerical solution allows the determination of critical amplitude in relation to wave number and Reynolds number. E.P.V.

N65-20927# Library of Congress, Washington, D. C. Aerospace Technology Div.
MIXING OF CONCENTRIC HIGH-VELOCITY AIRSTREAMS, COMPILATION OF ABSTRACTS Surveys of Soviet-Bloc Scientific and Technical Literature
22 Mar. 1965 37 p
(ATD-P-65-15; AD-459618) CFSTI: HC $3.00/MF $0.50

A compilation of abstracts of articles from the Soviet-Bloc scientific and technical literature on the subject of the mixing of concentric high-velocity airstreams is presented. E.E.B.

N65-20958# Aberdeen Proving Ground, Md. Exterior Ballistics Lab.
SIMULTANEOUS STREAK AND FRAME INTERFEROMETRY FOR USE IN SHORT DURATION HYPERVELOCITY FACILITIES
J. H. Spurk and D. D. Shear Dec. 1964 24 p refs
(BRL-R-1266; AD-460155)

A unique instrumentation system for simultaneous investigation of free stream and flows around a model in an expansion tube is described. A Mach–Zehnder interferometer with the proper combination of masks, filters, a dichroic mirror, and a rotating mirror are used. Streak interferograms of 400 μsec duration and framing records of 1 μsec duration are obtained. A streak interferogram in green monochromatic light gives a continuous history of the free-stream flow, while single frame interferograms in blue monochromatic light record the flow field about the model. The streak interferogram, in addition to monitoring quality of free-stream flow, can be used in conjunction with pressure, wave-velocity measurements, and perfect gas theory to determine free-stream conditions, notably static temperature, as necessary for the study of the flow around the model. An interferogram yields the local optical refractivity, which is a variable of state. For many applications, including the anticipated free stream conditions, this variable is simply proportional to density. Author

N65-20960# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Aachen (West Germany). Institut fur Theoretische Gasdynamik
INTERMEDIATE BALLISTICS [ZWISCHENBALLISTIK]
K. Oswatitsch Dec. 1964 50 p refs In GERMAN; ENGLISH summary
(DVL-358; DLR-FB-64-37) Available from ZLDI, Munich: 12,80 DM

The change processes between the states of interior ballistics and exterior ballistics in the vicinity of the muzzle are defined as Zwischenballistik (intermediate ballistics). This process is marked by the emission of gas from the barrel in front of the projectile and by the discharge of the propellant gases behind the projectile. In this connection the effect on the delivery of the projectile and the utilization of the propellant gas momentum are of special interest. A first concise exposition is given of the Zwischenballistik. Author

N65-20973# Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science
SECOND-ORDER SUPERSONIC SMALL DISTURBANCE THEORY
Keiichi Karashima Jan. 1965 52 p refs
(ISAS-392, Vol. 30, No. 1)

A study of plane and axially symmetric supersonic flow is made for the approximate inviscid theory of such comparatively thick bodies that the linearized equation does not adequately predict an essential feature of flow. The second-order small disturbance equations are derived for plane and axially symmetric motions involving shock waves and the range of applicability is shown from order estimation of the error involved in the approximation. For very high supersonic Mach numbers it is shown that the present approach is reduced to the first-order hypersonic small disturbance theory proposed by Van Dyke and, therefore, a single small disturbance theory may predict the flow at all supersonic speeds above the transonic. Experimental measurement of surface pressure distribution and observation of shape of the shock wave are made for a paraboloid-arc half-body of revolution with fineness ratio of 6.693 and for Mach 2, 3 and 8, and the results are compared with those of the present theory and others. It is concluded that the present theory agrees well with the method of characteristics and the experimental results also confirm the present approach. Author

N65-20982*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
AN EQUATION OF STATE OF GASES AT HIGH TEMPERATURES AND DENSITIES

J. S. Rowlinson 15 Aug. 1963 28 p refs
(Grant NsG-275-62)
(NASA-CR-51654; WIS-TCI-32) CFSTI: HC $2.00/MF $0.50

An equation-of-state is obtained in closed form for a gas composed of molecules with Lennard–Jones (n,1/2n) potentials. It is useful at temperatures above about 12 (ϵ/k), where $-\epsilon$ is the minimum energy of interaction and at all densities at which the equilibrium state is a fluid. It is derived by summing over all the cluster integrals of the virial expansion that occur in the approximation for the pair distribution function. Each cluster integral is represented correctly to terms of the order of n^{-1}. The equation agrees well with machine calculations of the pressure of dense gases for $n = \infty$ and $n = 12$, with static measurments of the compression of gases at high reduced temperatures, and with some preliminary measurements of the density of argon compressed by shock waves to pressures in the range 100 to 200 kb. Author

N65-21016# Massachusetts Inst. of Tech., Cambridge. Aerophysics Lab.
VISCOUS NONEQUILIBRIUM BLUNT BODY FLOWS
William C. L. Shih and Roy S. Krupp Nov. 1964 115 p refs
(Contract NOw-63-0575-d)
(TR-100; AD-613026)

A method is developed which effectively reduces the partial differential equations governing the continuum viscous thin shock layer region about a sphere to a set of total differential equations along radial lines across the shock layer. It is applied to regions downstream of the stagnation point. A systematic procedure is presented to obtain higher approximations in order that accuracy and consistency of the approximations made may be ascertained. Depending upon the degree of the approximation, the flow field may be determined along either one or more lines with coupling between the lines. Sample calculations for frozen, equilibrium, and nonequilibrium cases are included. Author

N65-21021# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
THERMOCAPILLARITY IN A LIQUID IN THE ABSENSE OF BODY FORCES
L. Ya. Lyubin and A. S. Povitskiy Feb. 1965 18 p refs Transl. into ENGLISH from Zh. Prik. Mekhan. i Techn. Fiz. (Moscow), no. 2, 1961 p 40–46
(RSIC-379; AD-612883)

Neglecting body forces, the motion of bubbles and drops in four cases is considered: (1) discrete bubbles of an ideal gas, extended in a train along and across the direction of motion; (2) a drop of an ideal liquid, not conducting heat, in a uniformly heated viscous fluid; (3) motion within liquid bodies; and (4) the rotation of a drop in a viscous liquid or gas near a hot baffle. For the solution of the external problem, the law of temperature distribution in the liquid is determined in steady irrotational motion. The form is similar to that of flow past a sphere or circular cylinder. An exact solution of the two-dimensional problem for a train of bubbles elongated across the motion is given, extended from other results on the flow of bubbles of an ideal liquid with a surface tension coefficient constant over the surface. For solution of the internal problem, only motion with a small Reynolds number is considered ($N_{Re} << 1$) which allows the omission of the term $(V\cdot\nabla)V$ in the Navier–Stokes equation for a liquid within an envelope. E.P.V.

N65-21057# Brown Univ., Providence, R. I. Div. of Applied Mathematics
INTERNAL ANGULAR MOMENTUM AND INTERNAL ENERGY OF FLUIDS
F. E. Bisshopp Jan. 1965 21 p refs
(Contract Nonr-562(07))
(TR-60; AD-612086)

A refinement of the usual equations of fluid dynamics applicable to fluids whose internal, rotational degrees of freedom provide observable effects is developed. The formulation proceeds along the lines of classical continuum mechanics and thermodynamics. Author

N65-21084*# Catholic Univ. of America, Washington, D. C. Dept. of Space Science and Applied Physics
MAGNETOHYDRODYNAMIC BOUNDARY LAYER BETWEEN PARALLEL STREAMS OF DIFFERENT MAGNETIC FIELDS AND TEMPERATURES
H. P. Pao and C. C. Chang Dec. 1964 43 p refs
(Grant NsG-586)
(NASA-CR-57845) CFSTI: HC $2.00/MF $0.50

An analysis and calculations of the free laminar boundary-layer flow between parallel streams of different magnetic fields and temperatures were made for an incompressible, viscous, thermally and electrically conducting fluid. Small perturbation and approximate solutions were given. The approximate solution for $\alpha = 1$ gives quite a satisfactory flow field which only involves a discrepancy of 1% from the exact numerical solution in most cases. The integration of the exact boundary layer equations was carried out and some calculations were shown. The magnetic field thickens the flow boundary layer and thus provides a stabilizing effect on the flow field. The possibility of an extension to the parallel streams of two fluids is also investigated. Author

N65-21104# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE SELF-MODELING MOVEMENTS OF AN IDEAL PERFECT HEAT-CONDUCTING GAS
S. I. Fadeyev 22 Dec. 1964 13 p refs Transl. into ENGLISH from Inzh. Zh. (USSR), v. 3, no. 2, 1963 p 367–373
(FTD-TT-64-502/1+2; AD-610354)

The model of an ideal perfect heat-conducting gas in which the viscosity is neglected corresponds to the high temperature processes in hydrodynamic approximations. The model of motion for a perfect heat-conducting gas with a large but finite value for the coefficient of heat conductivity was considered, with no unique solution obtained. E.P.V.

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N65-20238# Litton Systems, Inc., St. Paul, Minn. Applied Science Div.
SKYHOOK BALLOON FLIGHTS FLIN FLON, MANITOBA, CANADA
T. E. O'Malley and R. M. Dungan 10 Dec. 1964 72 p
(Contract Nonr-4567(00))
(Rept.-2650; AD-610109)

Six of the ten attempted balloon flights were operationally successful. Tracking by the theodolite-observation and radio-direction-finder bearings showed good results for the flight-duration and trajectory-distance observations, but were inadequate for payload recovery purposes. Float altitude variations occurred which appeared to correlate with the heavy cloud cover beneath the balloons. Data from gamma-ray detectors and associated scientific and balloon-control instrumentation are presented. G.G.

N65-20241# Minnesota Univ., Minneapolis. Dept. of Geology and Geophysics
TABULATION OF SEISMIC ARRIVAL TIMES AND CROSS-SPREAD TIMES, SKULL CLIFF, ALASKA, 1963
Thomas Fitch Oct. 1964 15 p
(Contract Nonr-710(44))
(TR-3; AD-610199)

This report presents a tabulation of arrival and cross-spread times for seismic records at Skull Cliff, Alaska, during the fall of 1963. The data were obtained during the course of a cooperative seismic refraction investigation of the Arctic Ocean Basin and the continental slope north from Barrow, Alaska. The purpose of this report is to make available the basic data obtained, together with auxiliary information on instrumentation and receiver location. Author

N65-20248# Tokyo Astronomical Observatory (Japan).
ANNALS OF THE TOKOYO ASTRONOMICAL OBSERVATORY, SECOND SERIES, VOLUME VIII, NUMBER 4
1964 33 p refs

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1. ON THE SECULAR VARIATION OF LONGITUDE (I) M. Torao and S. Okazaki 16 p refs (See N65-20249 10-13)
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N65-20249 Tokyo Astronomical Observatory (Japan).
ON THE SECULAR VARIATION OF LONGITUDE (I)
Masahisa Torao and Seichi Okazaki *In its* Ann. of The Tokyo Astron. Obs., Second Ser., Vol. VIII, No. 4 1964 16 p refs (See N65-20248 10-13)

Using the data of observations and comparisons of times made during 1933 to 1961, secular variations in the differences of the west longitudes among Tokyo, Europe (mean of 8 observatories), North America (mean of 2 observatories), South America (mean of 2 observatories), Tachkent and Zi-Ka-Wei were investigated. The results obtained from three different treatments—(1) using the annual means of the data for the whole period; (2) using 5 years means of the same data; and (3) solving separately for two periods before and after 1950—show that the existences of the secular variations in the differences of longitudes between the following pairs of the observatories can be concluded: Tokyo–Europe: +1.0 ms/year, Tokyo–North America: +1.4 ms/year, Tokyo–South America: +1.6 ms/year, and North America–Europe: −0.4 ms/year. Author

N65-20250 Tokyo Astronomical Observatory (Japan).
ON THE ABRUPT CHANGE IN THE EARTH'S ROTATION AT THE BEGINNING OF 1963
Shigetaka Iijima, Naoyuki Matsunami, and Seichi Okazaki *In its* Ann. of the Tokyo Astron. Obs., Second Ser., Vol. VIII, No. 4 1964 14 p refs (See N65-20248 10-13)

An abrupt increase of the rate of rotation of the earth by about 5 parts in 10^9 was detected at the beginning of 1963. In this paper an explanation for the abrupt change of the earth's speed is tried by the cause of the meteorological anomaly. The result of calculation gives the expected change of the earth's speed by about 4 parts in 10^9, which is in good agreement with the observational data. The motion of the instantaneous pole of the earth in this same period may be considered somewhat unusual, and the explanation for this is also tried by the same meteorological causes. The result of calculation is also proved to be good enough to explain this phenomenon. Author

N65-20284# Wisconsin Univ., Madison. Dept. of Meteorology
STUDIES OF THE EFFECTS OF VARIATIONS IN BOUNDARY CONDITIONS ON THE ATMOSPHERIC BOUNDARY LAYER Second Annual Report 1964
Heinz H. Lettau Dec. 1964 123 p refs
(Contract DA-36-039-AMC-00878)
(AD-611209)

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1. PRELIMINARY RESULTS OF AN AIR MASS MODIFICATION STUDY OVER LAKE MENDOTA A. B. Super p 1–21 refs (See N65-20285 10-13)
2. A THERMAL RESPONSE EXPERIMENT ON LAKE ICE J. C. Turner p 23–57 refs (See N65-20286 10-13)
3. REPORT ON WIND PROFILE MODIFICATION EXPERIMENTS USING FIELDS OF CHRISTMAS TREES ON THE ICE OF LAKE MENDOTA C. Stearns p 59–97 refs (See N65-20287 10-13)
4. PRELIMINARY NOTE ON THE EFFECT OF TERRAIN-SLOPE ON LOW-LEVEL JETS AND THERMAL WINDS IN THE PLANETARY BOUNDARY LAYER H. Lettau p 99–115 refs (See N65-20288 10-13)

N65-20285 Wisconsin Univ., Madison. Dept. of Meteorology
PRELIMINARY RESULTS OF AN AIR MASS MODIFICATION STUDY OVER LAKE MENDOTA
Arlin B. Super *In its* Studies of the Effects of Variations in Boundary Conditions on the Atmospheric Boundary Layer Dec. 1964 p 1–21 refs (See N65-20284 10-13)

Case studies of airmass modification in the lowest 3m above Lake Mendota (41 km^2 surface area) made with the aid of a specially instrumented pontoon boat, are discussed. The instrumentation on this boat is described in detail. Measurements include wind speed, air temperature and wet-bulb temperature at five levels above the air–water interface, and water temperature. Vertical profile structure is studied as a function of several kilometers of horizontal fetch by making runs across the lake into the mean wind. Budgets based on horizontal and vertical mean-motion transports of momentum, sensible heat, and latent heat and eddy transfer are calculated and graphed. Especially interesting conditions prevail on summer days; when the airflow is from rough and heated land to the smooth water surface with changes to inversion, wind speed increases first, and decreases after about 2 km of fetch. Author

N65-20286 Wisconsin Univ., Madison. Dept. of Meteorology
A THERMAL RESPONSE EXPERIMENT ON LAKE ICE
John Colin Turner *In its* Studies of the Effects of Variations in Boundary Conditions on the Atmospheric Boundary Layer Dec. 1964 p 23–57 refs (See N65-20284 10-13)

A preliminary experiment was carried out to examine the thermal response of lake ice to a square-wave radiation forcing function, induced by alternate shading and unshading of

the surface by a mobile screen, with a range of periods from 4 to 40 minutes. The results indicated a general agreement with theoretical predictions but were inconclusive because of measurement deficiencies. Suggestions for future studies are made, including possible modifications of surface roughness and albedo, and the harmonic analysis of results to separate out the first harmonics. Author

N65-20287 Wisconsin Univ., Madison. Dept. of Meteorology
REPORT ON WIND PROFILE MODIFICATION EXPERIMENTS USING FIELDS OF CHRISTMAS TREES ON THE ICE OF LAKE MENDOTA
Charles Stearns *In its* Studies of the Effects of Variations in Boundary Conditions on the Atmospheric Boundary Layer Dec. 1964 p 59-97 refs (See N65-20284 10-13)

The experiments on wind profile structure within and above an artificial Christmas tree forest "planted" on the Lake Mendota ice were made in March 1964. Profile changes were measured within and outside the forest. The results show that at a given downwind distance within the trees the wind profile shape will be duplicated with winds of different velocities and direction for two specific areas of 4.0 and 2.1 m^2 per Christmas tree. The results also show that airflow and weather conditions under which the experiment is done must be carefully chosen so that profiles within the trees may be unambiguously related to the undisturbed conditions. Author

N65-20288 Wisconsin Univ., Madison. Dept. of Meteorology
PRELIMINARY NOTE ON THE EFFECT OF TERRAIN-SLOPE ON LOW-LEVEL JETS AND THERMAL WINDS IN THE PLANETARY BOUNDARY LAYER
H. Lettau *In its* Studies of the Effects of Variations in Boundary Conditions on the Atmospheric Boundary Layer Dec. 1964 p 99-115 refs (See N65-20284 10-13)

It is suggested that a factor favoring low-level jetstream development at nighttime is a large-scale terrain slope at which the daily cycle of solar heating sets up a systematic diurnal variation of the thermal wind. For extended slopes of suitable orientation a significant enforcement of the conventional mechanism will result. This effect is demonstrated by deriving a closed solution for, and computation of, the distortion of Ekman profiles caused by a harmonically varying thermal wind in the planetary boundary layer, as produced by solar heating of sloping ground. Certain consequences of the concept are discussed. Author

N65-20296# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 164: SUMMER ATMOSPHERIC CIRCULATION OF EAST ASIA
Shih-yen T'ao, I-ping Hsieh, and Tu-cheng Hua 29 Mar. 1965 31 p refs Translated into ENGLISH from K'O-Hsueh T'ung Pao (Peking), no. 1, 17 Jan. 1965 p 8-24 Presented at the 1964 Peking Sci. Symp.
(JPRS-29316; TT-65-30601) CFSTI: $2.00

Principal characteristics of average summer wind circulation for East Asia are shown by pressure diagrams and latitude directional wind speed cross sections. The arrival and recession of summer circulation, the East Asian subtropical flow, principal summer weather systems, and the influence of the Western Pacific subtropical high pressure region are discussed. E.W.

N65-20325 India. Dept. of Atomic Energy, Bombay. Nuclear Physics Div.
RECENT ADVANCES IN SEISMOLOGY
H. M. Iyer 1964 14 p Also published in J. of the Indian Geophys. Union (Bombay), v. 1, no. 2, Apr. 1964 p 63-76
(AEET-NP-11)

Some of the developments of new ideas arising out of the recent worldwide interest in seismology are discussed. The emphasis is mainly on techniques of instrumentation and fast computation that have become possible only during the past few years. Author

N65-20412# Joint Publications Research Service, Washington, D. C.
STUDY OF LIGHTNING AND LIGHTNING PROTECTION
I. S. Stekol'nikov 2 Apr. 1965 147 p refs Transl. into ENGLISH of the book "Izucheniye Molnii i Grozozashchita" Moscow, 1955 p 1-159
(JPRS-29407; TT-65-30639)

A general review of lightning formation, the development of lightning, and the methods of protection against it is presented. Also methods of lightning discharges are considered, as are investigations of long sparks obtained by artificial means in a high-voltage laboratory. R.W.H.

N65-20539# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SUPPORTING NETWORK OF FOREIGN GRAVIMETRIE SURVEYS
A. I. Bayborodin 13 Jan. 1965 23 p refs Transl. into ENGLISH from Tr. Tsentr. Nauchn.-Issled. Inst. Geodezii, Aeros'yemki i Kartografii (Moscow), no. 139, 1960 p 61-75
(FTD-MT-64-262; AD-612375)

The values of gravity of all primary national gravimetric survey points were calculated. Divergence of earlier figures from these values does not exceed 1 milligal, except for a few places. Errors of measurements are discussed and data presented. E.E.B.

N65-20602# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering
A THEORETICAL STUDY OF THE SHOCK WAVE ORIGIN OF SHATTER CONES
George P. Johnson and Richard J. Talbot (M.S. Thesis) Aug. 1964 104 p
(GSF/MECH-64-35; AD-610224)

An investigation which considers the hypothesis that shatter cones are caused by the action of very strong shock waves resulted in the theory that conical fracture surfaces will be produced as the result of the interaction of a shock wave with a small obstacle. The obstacle is a region of anomalous density and/or compressibility in the transmitting medium. The shock wave must have the property that the amplitude of the compressive stress at and behind the front must be equal to the yield strength of the transmitting medium. Shock waves of this type, called elastic precursors, are known to be produced by high energy impacts and explosions. The conical fractures predicted by the theory have many features which correspond to those observed in shatter cones. In addition, the distribution and orientation of the cones predicted by the theory correlate well with those which are observed for the cones in situ. Author

N65-20855# Weapons Research Establishment (Australia).
IONOSPHERIC DATA FOR JULY 1964 FROM SALISBURY, SOUTH AUSTRALIA
Oct. 1964 26 p *Its* Ionospheric Data Bull. CPD 1964/7 (S)

Tables of the hourly values of the customary ionospheric parameters are given for the station at Salisbury for July 1964. Author

N65-20864# Stanford Research Inst., Menlo Park, Calif. Geophysics Dept.
LOCAL SEISMICITY INVESTIGATIONS FOR ON-SITE INSPECTIONS—PROJECT VELA CLOUD GAP Quarterly Report, 1 Oct. 1964–1 Jan. 1965
Warren H. Westphal 11 Jan. 1965 5 p
(Contract AF 49(638)-1363; ARPA Order-292; ARPA Order-500)
(QR-4; AD-610001)

The fourth seismograph unit was placed in operation at SALMON. In this unit the tape recorder, seismic amplifiers, time-code generator, and associated control and test circuits are all in one waterproof container, which is lighter and occupies considerably less volume than the previous containers, which hold only the amplifiers and time-code generator. No aftershock activity was recorded by the seismographs which operated in the vicinity of the Tatum Salt Dome both prior to and for 100 hours following the SALMON event. Seismograph locations and spans of recording time at each of the areas investigated are reported. E.E.B.

N65-20870# Aerospace Corp., El Segundo, Calif. Space Physics Lab.
ABSORPTION, PHOTOIONIZATION, AND FLUORESCENCE OF SOME GASES OF IMPORTANCE IN THE STUDY OF THE UPPER ATMOSPHERE
G. R. Cook and B. K. Ching 30 Jan. 1965 225 p refs
(Contract AF 04(695)-469)
(TDR-469(9260-01)-4; SSD-TDR-64-16; AD-458631)

Absorption and photoionization coefficients and fluorescence of some gases of particular interest to upper atmospheric research were measured using a 1-m Seya-type scanning vacuum ultraviolet monochromator with a resolution of 0.2 to 0.8 Å. The investigation covered the wavelength region 600 to 1000 Å for all the gases; for O_2, the region of the Schumann–Runge continuum (1050 to 1800 Å) was also included. The results are discussed, and compared with those of other investigators. Author

N65-20883*# National Aeronautics and Space Administration, Washington, D. C.
ACTINOMETRIC OBSERVATION TECHNIQUES AT SEA [O METODIKE AKTINOMETRICHESKIKH NABLYUDENIY V MORE]
D. L. Grishchenko, Ye. P. Novosel'tsev, and N. Ye. Ter-Markaryants Apr. 1965 15 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 152, 1964 p 212–221
(NASA-TT-F-330) CFSTI: HC $1.00/MF $0.50

The methods proposed for measuring direct solar radiation, total solar radiation, reflected radiation, and the radiation balance at sea are presented. An evaluation is given of the accuracy of actinometric measurements from ships. Author

N65-20888# Weston Observatory, Mass.
RESEARCH DIRECTED TOWARD THE COLLECTION, REDUCTION AND EVALUATION OF GEOMAGNETIC FIELD DATA AND ELECTRIC FIELD PHENOMENA, ATMOSPHERIC AND TERRESTRIAL Final Report
John F. Devane 30 Nov. 1964 80 p refs
(Contract AF 19(628)-236)
(AFCRL-64-966; AD-460473)

A coil facility to reproduce magnetic fields encountered by space vehicles was constructed. Support in the form of purchasing, personnel, and testing was provided for the deep-space magnetic field measurement program. Data from rocket-borne magnetometers were reduced. Theoretical studies of various aspects of the earth's magnetic field were undertaken. A local index of magnetic activity was developed. Explanations of the daily variation and of micropulsations were investigated. Since magnetic storms are hydromagnetic disturbances generated at the magnetosphere by an enhanced solar wind and subsequently propagated through the magnetic field, theoretical studies included many phases of the physics of magnetic storms. Author

N65-20906# Uppsala Univ. (Sweden). Geodetic Inst.
RESEARCH ON METHODS OF DETERMINING LEVEL SURFACES OF THE EARTH'S GRAVITY FIELD Final Report, 1 May 1959–30 Apr. 1964
Erik Tengstrom and Andreas Vogel 30 Jun. 1964 67 p refs
(Contract AF 61(052)-226)
(AFCRL-65-95; AD-613010)

New and different attempts to study the level surfaces of the earth's gravity field and also their secular variations are reported. These include: (1) the theoretical possibility of determining refraction by measuring the dispersion angle between rays of visible light with different wavelengths; (2) a description of two instruments for measuring such dispersion-angles; (3) determining geoidal deflections, by using data together with astrogeodetic deflections; (4) an extrapolation method for the upwards continuation of gravity and deflections; and (5) use of horizontal pendulums for detecting an eventual secular variation of gravity, due to the dynamical properties of the outer core. Author

N65-20987*# National Aeronautics and Space Administration, Washington, D. C.
COMPUTING THE SPECTRAL DISTRIBUTION OF THE BRIGHTNESS OF THE CLOUDLESS SKY IN A TWO-PARAMETER MODEL OF THE ATMOSPHERE [K RASCHETU SPEKTRAL'NOGO RASPREDELENIYA YARKOSTI BEZOBLACHNOGO NEBA V DVUKHPARAMETRICHESKOY MODELI ATMOSFERY]
V. K. Kagan and Ye. P. Ryabova Apr. 1965 19 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 152, 1964 p 16–30
(NASA-TT-F-318) CFSTI: HC $1.00/MF $0.50

The calculation procedure is presented for the spectral distribution of the brightness of the clear sky in accordance with the scheme of K. S. Shifrin and I. N. Minin. Tables are presented for the values of quantities and auxiliary functions which are contained in the equation of V. V. Sobolev for determining the brightness coefficient. Author

N65-20994*# Michigan Univ., Ann Arbor.
ATMOSPHERIC SLANT PATH TRANSMISSION IN THE 15μ CO_2 BAND
S. Roland Drayson Washington, NASA, Apr. 1965 110 p refs
(Contract NASr-54(03))
(NASA-TN-D-2744) CFSTI: HC $4.00/MF $0.75

Calculations were made of high-resolution atmospheric slant path transmission in the 15μ CO_2 band, by direct integration across the band. Mixed Doppler–Lorentz broadening

was used at pressures lower than 100 mb, and a method to eliminate the Curtis–Godson approximation was developed and applied. Comparison with band model calculations shows large discrepancies. Some applications are discussed, together with an outline of future work. Fortran programs and transmission tables are presented. Author

N65-21075# Brussels Univ. (Belgium). Service de Geochimie
STUDY OF COAL AS A SOURCE OF BERYLLIUM [ETUDE DU CHARBON COMME SOURCE DE BERYLLIUM]
J. Jedwab Brussels, EURATOM, Dec. 1964 51 p refs In FRENCH; ENGLISH summary
(Contract EURATOM-001-60-11 GEOB)
(EUR-2106.f) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 85 Belg. Fr.

A quantitative study was carried out on the distribution of beryllium in Belgian, Dutch, French, and German coal, with a view to determining the beryllium content in ash and entire coal, in terms of geography, stratigraphy, and petrography. Products of heat combustion, carbon chemistry, and metallurgy were also analyzed. In certain of these coals the scandium and germanium content and distribution were studied. The chemical bond of the beryllium found in ash appears to be very stable towards inorganic solvents. Author

N65-21097# American Meteorological Society, Boston, Mass.
TRIGONOMETRIC LEVELING ALONG THE PROFILE KOMSOMOL'SKAYA-SOVETSKAYA-VOSTOK-KOMSOMOL'SKAYA [TRIGONOMETRICHESKIE NIVELIROVANIE NA PROFILE KOMSOMOL'SKAIA-SOVETSKAIA-VOSTOK-KOMSOMOL'-KAIA]
G. E. Lazarev Bedford, Mass., AFCRL, Jun. 1964 16 p ref Transl. into ENGLISH from Geofiz. Byull. (Leningrad), no. 13, 1963 p 49–56
(Contract AF 19(628)-3880)
(T-R-444; AD-609929)

The characteristics of the observational method and some physicogeographic data along the route are summarized. The route passed through a wasteland more than 3500 meters high with practically no orientation points. This is a region of nearly impassable loose snow and extreme cold. The density and hardness of the snow gradually decreases with distance from the coastal belt of strongest winds. Low temperature exerted a great influence on the passability of snow. The state of the atmosphere was characterized by summarizing the pressure, temperature, humidity, cloud cover, and visibility, and their effect on human activity, instrument operation, and the accuracy of measurements. It was concluded that trigonometric leveling may be employed even under the severe conditions of the Antarctic interior on long traverses (> 1500 km) at a good rate of progress (up to 65 km/day). E.E.B.

N65-21125# Defence Research Board, Ottawa (Canada).
ELECTRON NUMBER DENSITY VS REAL HEIGHT TABULATIONS. ALOUETTE 1, IONOSPHERIC DATA N (h), VOLUME 2, NO. 1
[1965] 367 p

Electron density profiles for selected ionograms from the Alouette I topside sounder satellite are presented. Electron density profiles are shown for specified sequences of satellite positions and times; solar zenith angle, earth magnetic field dip and gyrofrequency at the satellite, ordinary wave frequency for highest number density computed for the ionogram, and a subjective quality rating for the ionogram, are listed with each profile. Most of the profiles were calculated from the extraordinary wave reflection trace by a lamination method. The gyrofrequency was used in computing the matrix elements for the lamination analysis and for conversion of extraordinary wave frequency to electron density. Real-height calculations are given for the satellite, by time and position. J.M.D.

N65-21147# Technisch Documentatie en Informatie Centrum voor de Krijgsmacht, The Hague (Netherlands).
A REVIEW OF LITERATURE ON OCEANOGRAPHY AND NAVIGATION, VOLUME 2, NO. ON-4
10 Jan. 1965 39 p refs

Abstracts and bibliographic notes are included for oceanography, subdivided into categories of institutes and research programs, hydrography and descriptive oceanography, physical oceanography, geophysics, and oceanographic and hydrographic equipment; and for navigation, categorized by general sea-, air-, and space-navigation problems, integrated electronic navigation equipment, specific radio-navigation equipment, navigational radar- and radar-plotting instruments, general navigation instruments and aids, and technical news and book reviews. E.P.V.

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N65-20192# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Munich (West Germany). Institut für Physik der Atmosphäre
SOME METHODS OF THROUGHPUT MEASUREMENTS IN PARTICLE SEPARATORS FOR MEASUREMENT FLIGHTS IN HIGH ATMOSPHERIC ALTITUDES [UBER EINIGE METHODEN DER DURCHSATZMESSUNG AN SCHWEBSTOFF-ABSCHEIDERN FUR MESSFLUGE IN GROSSEN HOHEN IN DER FREIEN ATMOSPHARE]
Th. Dahlem and D. Paffrath Dec. 1964 52 p refs In GERMAN; ENGLISH summary
(DVL-383; DLR-FB-64-33) Munich, ZLDI: 12.50 DM

Methods have been developed for measuring the air throughput in particle separators for airborne particles. These methods permit determination of the total integral air volume over a flight path with variable altitude and velocity of the airplane. A mechanical type of windmill anemometer for measuring the integral air volume, and an electrical type of windmill anemometer for measuring the differential mean rate of flow have been built and tested for this purpose. In addition, a simple electrical integrator has been developed which integrates the variable voltage originating from the electrical anemometer in such a way that the result is proportional to the total number of propeller revolutions during the measuring period (analog-to-digital converter). Author

N65-20197# Wissenschaftliche Gesellschaft für Luft- und Raumfahrt, Cologne (West Germany).
AERODYNAMIC MEASUREMENT TECHNIQUE [AERODYNAMISCHE MESSTECHNIK]

Jul. 1964 129 p refs In GERMAN Report of the Subcomm. Meeting, Berlin, 10 Sep. 1963
(DLR-Mitt.-64-04) Munich, ZLDI: 31 DM

The following subjects are discussed: *Some Basic Principles of the Turbulence Theory; Fundamentals of the Constant-Flow Hot Wire Measuring Technique; Fundamentals of Automatic Self-adjustment to Constant Temperature of Hot Wire Anemometers; Construction of a New Constant-Temperature Hot Wire Anemometer; Comparison of Theoretical and Measured Temperature Values of a Finite Length Hot Wire; Comparison of Wire- and Layer-Resistance Indicators; Methods for Direction Measurements by Hot Wire Technique with X- and V-Sondes;* and *Possibilities of the Consideration of Quasi-Stationary Variations in the Environmental Temperature of Hot Wire Sondes in the Constant-Temperature Method.* Trans. by G.G.

N65-20253 Joint Publications Research Service, Washington, D. C.
STUDY OF EXCITATION OF EXTRA-SOFT X-RAY RADIATION
F. N. Kharadzha and S. A. Ivanov *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 6, 1964 24 Mar. 1965 p 1-9 refs (See N65-20252 10-09) CFSTI: $5.00

The article describes an instrument permitting the simulation of the operating regime of an ionization vacuum gage and the measurement of the photoemission from the collector under the effects of soft X-rays. Some test results for the instrument are also given. It was established that the regularities in the excitation of X-ray radiation by accelerating voltages from tens and hundreds of volts greatly differ from the regularities observed at high voltages. It turned out that the intensity of extra-soft radiation does not change monotonously with voltage rise and is not in a linear relation to the anode material's atomic number. Author

N65-20265 Joint Publications Research Service, Washington, D. C.
A GYROSCOPIC SYSTEM WITH A REVERSIBLE KINETIC MOMENT
L. I. Kargu *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 6, 1964 24 Mar. 1965 p 85-91 refs (See N65-20252 10-09) CFSTI: $5.00

A gyroscopic system which has practically instantaneous reversal of its kinetic moment is examined. In this system the time required for reversal is determined by the operating time of electromagnetic components that need only hundredths or even thousandths of a second. A general description and possible modes of operation are presented. E.E.B.

N65-20266 Joint Publications Research Service, Washington, D. C.
A CONTRIBUTION TO THE METHOD PROPOSED BY M. M. RUSINOV FOR PROCEEDING FROM A SYMMETRICAL OBJECTIVE TO AN ASYMMETRICAL ONE
O. N. Vasilevskiy *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 6, 1964 24 Mar. 1965 p 92-98 refs (See N65-20252 10-09) CFSTI: $5.00

Formulas are derived which permit computation of the variation in spherical aberration of the third order occurring in switching from a symmetrical objective with a magnification of $\nu \neq -1$ to an symmetrical one with a magnification of $\nu \neq -1$ by the method of M. M. Rusinov. When using this method the third-order aberration coefficients obtained with $\nu \neq -1$ are considerably smaller than the coefficients of the initial system with the same magnification. Author

N65-20269 Joint Publications Research Service, Washington, D. C.
DIFFERENTIAL MANOMETER FOR A P-v-T DEVICE
A. V. Kletskiy *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 6, 1964 24 Mar. 1965 p 113-115 refs (See N65-20252 10-09) CFSTI: $5.00

A glass mercury differential manometer, designed to measure pressures of approximately 100 bars at temperatures up to 200° C, is described. The gland packing was replaced by a temperature and mechanically compatible glass-metal seal, carefully annealed to increase the mechanical strength of the seal. The instrument was made resistant to shock breakage by elastic suspension with the aid of steel capillaries and a base spring support, and was placed inside a case with a glass front. Only an insignificant volume of test substance above the mercury is required. E.E.B.

N65-20273 Joint Publications Research Service, Washington, D. C.
PRECISION ALIGNMENT OF RECTILINEAR MOVEMENT OF A MICROSCOPE STAGE
I. M. Dolinskiy *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 6, 1964 24 Mar. 1965 p 142-143 refs (See N65-20252 10-09) CFSTI: $5.00

The design of a semiautomatic microscope for the measurement of particle pulses, in which the carriage can be displaced in a straight line with a limit accuracy of 0.014 microns over measured intervals of 500 microns by means of V-shaped guides, is announced. The cumulative error in linear displacement over the entire range of the microscope stage of 60 mm does not exceed 0.12 microns. The carriage is mounted on three fluorine plastic cylinders, sliding in brass tracks without lubrication. E.E.B.

N65-20313# Naval Research Lab., Washington, D. C. Shock and Vibration Information Center
THE SHOCK AND VIBRATION BULLETIN, NO. 34, PART 4
Feb. 1965 263 p refs Proc. of the 34th Symp. on Shock, Vibration, and Assoc. Environments, Pacific Grove, Calif. 13-15 Oct. 1964
(AD-460002)

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4. A TELEMETRY STANDARD FOR VIBRATION AND ACOUSTIC MEASUREMENTS E. J. Kirchman and Frank J. Holley p 63-72 refs (See N65-20317 10-14)

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7. MEASUREMENT OF RELATIVE DEFLECTIONS OF A GROUND MAPPING RADAR ANTENNA IN A VIBRATION ENVIRONMENT E. F. Dyer p 103-106 (See N65-20320 10-07)

8. EXPERIMENTAL RESULTS OF THE APPLICATION OF SAMPLING TECHNIQUES TO VARIOUS TYPES OF FLIGHT DATA J. Sudey, Jr. p 107–114 refs (See N65-20321 10-07)

N65-20314 Lockheed Missiles and Space Co., Sunnyvale, Calif.
NEW INSTRUMENT FOR ACCELEROMETER CALIBRATION
D. R. Workman *In* NRL Shock and Vibration Bull. Feb. 1965 p 31–39 refs (See N65-20313 10-14)

A system for routine calibration of large quantities of accelerometers with good precision and minimum testing time is described. A new type of instrument used in conjunction with a conventional back to back calibration system is presented, along with its error analysis and method of use in a calibration system. Author

N65-20315 Grumman Aircraft Engineering Corp., Bethpage, N. Y.
DEVELOPMENT OF AN OMNIDIRECTIONAL ACCELEROMETER
L. E. Dunbar *In* NRL Shock and Vibration Bull. Feb. 1965 p 41–44 (See N65-20313 10-14)

A program to develop to prototype form an accelerometer sensitive only to the magnitude of applied acceleration is discussed. The program's intent is to apply the device as a lunar soil penetrometer. The principle and design are directly applicable to shock-mount evaluation and other similar needs of the packaging industries in which the direction of the sensed acceleration is of no concern. The instrument achieves this through flexural elements and produces a high level dc output signal. In the breadboard model, on which tests will be performed, the instrument occupies a 3 × 3 × 3-inch volume. The production unit is expected to have one-fourth the bulk. The design goal is 2% overall accuracy, a 50-g range, and a natural frequency of 100 cps. Author

N65-20316 Lockheed-California Co., Burbank.
USE OF MINIATURE FORCE TRANSDUCERS IN THE MEASUREMENT OF SHOCK AND VIBRATION ENVIRONMENTS
G. W. Painter *In* NRL Shock and Vibration Bull. Feb. 1965 p 45–53 (See N65-20313 10-14)

A new miniature force transducer with a washer configuration and incorporating piezoresistive strain gages is discussed. This transducer is sufficiently sensitive to allow measurement of forces as low as a few pounds; yet its mass and compliance are so low that it can be introduced between the equipment and supporting structure with negligible effect on the response characteristics of the system. Included are performance characteristics of the transducer and typical force data obtained from a complex structure subjected to shock and vibration excitation. Author

N65-20317 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A TELEMETRY STANDARD FOR VIBRATION AND ACOUSTIC MEASUREMENTS
E. J. Kirchman and Frank J. Holley *In* NRL Shock and Vibration Bull. Feb. 1965 p 63–72 refs (See N65-20313 10-14)

The FM constant deviation uses the carrier capabilities up to 200 kc and requires only new modulation and plug-in frequency units for existing demodulation equipment. It is entirely compatible with all missile range recording stations. As a laboratory instrument, a constant deviation multiplexing data system has been in operation for over a year. The limitations on signal noise and phase shifting and the advantages and disadvantages are discussed, as well as particular problems. Author

N65-20318 Pan American World Airways, Inc., Patrick AFB, Fla.
MEASURING LAUNCH-ABORT ENVIRONMENT
Cyril N. Golub *In* NRL Shock and Vibration Bull. Feb. 1965 p 73–79 (See N65-20313 10-14)
(Contract AF 08(606)-5300)

The basic environmental parameters can either be measured directly by a pad-abort measuring system in the event of an abort occurring on the launch pad, or be inferred from various properties measured from a distance by a remote abort measuring system in the event of an abort occurring in flight. The unpredictability in time and space and the short duration of the events, the wide dynamic range of the values to be measured, and the inaccessibility and the complexity of the aborts occurring in flight are some of the problems to be solved by these instrumentation systems. The pad-abort measuring system uses contact-type sensors; an array of pressure transducers centered about the launch point to measure shock wave intensity and velocity and a system of thermocouples, radiometers, and calorimeters to measure fireball temperatures and thermal emission. Pressure and thermal data are recorded on magnetic tape. Documentary and engineering sequential photography is used to map the size and growth rate of the fireball and to record any evidence of the existing dynamic forces. Author

N65-20319 Northrop Corp., Palos Verdes Estates, Calif. Nortronics Div.
DYNAMIC RESPONSE OF A DIGITAL MAGNETIC FORCE-REBALANCE PENDULOUS ACCELEROMETER TO A VIBRATIONAL ENVIRONMENT
L. R. Beuder and R. C. Rountree *In* NRL Shock and Vibration Bull. Feb. 1965 p 81–101 refs (See N65-20313 10-14)

Two simplified techniques to analyze the vibration response of a state-of-the-art accelerometer control system are demonstrated. Both utilize an ideal relay model to account for a complex digital network in the system's nonlinear feedback path. A filtered frequency response is determined by a unique application of a dual-input describing function, use of which permits accurate evaluation of vibration response levels causing quenching of the loop's autonomous mode of operation. A linearized sinusoidal frequency response is used to determine the power spectral density of the accelerometer pendulum response to a random vibration input. Results of vibration tests (sinusoidal and random) of an actual accelerometer system are presented. The results of analysis and test were found to correlate in most cases with reasonable accuracy, considering the approximations involved. Author

N65-20350# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering
DEVELOPMENT OF A DIRECT READING FLOW METER
David John South (M.S. Thesis) Aug. 1964 67 p refs
(GA/ME/64-6; AD-610177)

An electronic device used with a sharp-edged orifice to directly measure the mass flow rate of gaseous fluids uses potentiometer-type pressure transducers to measure the pressure upstream and across the orifice and operates on three measurements to produce an indication of mass flow rate. The flow meter is a small self-contained unit; the electrical

inputs from the transducers enter the device through connectors on the chassis. Differential amplifiers, cathode followers, and a regulated power supply reduce drift. A zener diode network is used to establish a circuit whose output voltage is proportional to the reciprocal of its input voltage. Experiments using the flow meter indicate that measurement errors are on the order of 10% or less over a flow range of 20 to 1 if 2 orifices are used. Only compressed air was used during the tests. Author

N65-20414*# Geophysics Corp. of America, Bedford, Mass.
DEVELOPMENT OF COLD CATHODE IONIZATION GAUGES FOR SPACE VEHICLES. PART I: RESEARCH AND DEVELOPMENT Final Report
Wallace S. Kreisman Nov. 1964 143 p refs
(Contract NAS5-3353)
(NASA-CR-57594; GCA-TR-64-17-N) CFSTI: HC $4.00/MF $1.00

A study was made of the characteristics of standard and experimental magnetron-type cold cathode ionization gages to better understand their operation and improve their performance. Among the characteristics studied were gage sensitivity, stability, linearity, ion energy distribution, space charge distribution, and current flow distribution. Discharge instability within certain narrow ranges of anode voltage was observed. Hysteresis in the current–voltage characteristic was discovered that could explain multimode operation. One experimental gage was constructed to be used as a low resolution mass spectrometer. The importance of the cathode surface in determining the nature of the discharge was demonstrated.
Author

N65-20415*# Cornell Univ., Ithaca, N. Y. Center for Radiophysics and Space Research
REPORT OF FIELD TEST FOR TIGRIS
Jan. 1965 32 p Sponsored by NASA
(NASA-CR-57621; CRSR-187) CFSTI: HC $2.00/MF $0.50

The TIGRIS (Televised Images of Gaseous Regions In Space) camera system was field tested under dark sky conditions to demonstrate its high sensitivity in detecting and defining the shapes of faint, extended light sources. Several monitor and oscilloscope photographs are included with discussions on sensitivity, localized sensitivity changes, white edge effects, star image erasure, and long persistence monitor tube effect. A number of undesirable effects, partially attributable to using an untested image orthicon tube, include severe shading, clamping difficulty, and an output caused by camera reorientation. These effects may be closely related and thus, simultaneously solved. R.N.A.

N65-20421*# Parametrics, Inc., Waltham, Mass.
LOW LEVEL RADIATION ALTIMETER SYSTEM STUDY
L. L. Bird and C. A. Ziegler 15 Oct. 1963 81 p refs
(Contract NAS9-1490)
(NASA-CR-57637) CFSTI: HC $3.00/MF $0.75

Several nuclear radiation techniques were studied as possible means for altitude measurement above the lunar surface, for the range of 0 to 50 ft. Both direct (sources ejected and located on the surface during measurement) and indirect (source aboard the vehicle) systems were considered. Indirect charged particle systems were rejected because of attenuation effects in the rocket exhaust gas, while neutron systems were ejected because of the large amount of hardware required. A gamma-backscatter system, using photons of moderate energy (60 keV) was found to be very promising since the source strength requirement (~12 curies) is practical and the weight of the source and detector could be small (~5 lbs.). Author

N65-20426# Hughes Aircraft Co., Culver City, Calif. Display Systems Dept.
ANALYSIS OF PICTORIAL DISPLAYS, JANAIR, JOINT ARMY-NAVY AIRCRAFT INSTRUMENTATION RESEARCH First Quarterly Report
W. L. Carel and A. Zilgalvis Sep. 1964 41 p refs
(Contract Nonr-4468(00))
(Rept.-2732-01/19; AD-606705)

The object of this program is the specification of pictorial display systems that will be useful in restricted approach and landing, low-level and high-speed flight, point-to-point navigation, weapon delivery, and tactical air operations. To reach this goal, a large family of displays are considered from the viewpoint of hardware engineering and the design of the pilot–display interface. A hardware review of display media, sensors, and T.V. bandwidth compression techniques has commenced. The candidate vertical pictorial displays were isolated into three classes. Type I consists of displays that may be called literal and are exemplified by ordinary closed-loop T.V. systems; however, such literal pictures of the real world may lack the color and depth afforded by binocular visual cues. Type II displays are analog displays identical to those generated by the contact analog computers. Type III displays are skeletal, like those used in heads-up displays. The use of any unaided literal vertical raster scan display appears risky on the basis of gathered evidence, but a system incorporating the advantages of a pictorial representation in an aided literal display is being designed. R.W.H.

N65-20514# Royal Aircraft Establishment, Farnborough (England).
MEASUREMENTS OF THE RESPONSE OF VARIOUS THERMOCOUPLE ARRANGEMENTS
F. H. Irvine, J. Picken, and G. H. Greenwood London, Min. of Aviation, Apr. 1964 25 p refs
(RAE-TN-AERO-2959)

This note presents some laboratory measurements of the responses of chromel and alumel thermocouple arrangements currently used or proposed for free-flight investigations. These show that the mode of construction is very important. A thermocouple constructed by welding wires individually to a calorimeter wall is greatly superior to one which uses a preformed bead. The material of the wall to which thermocouples are attached and the diameter of the thermocouple wires may also be significant. A tentative empirical relation which describes the effect of these parameters is presented. Author

N65-20521# Army Missile Command, Huntsville, Ala. Structures and Mechanics Lab.
EFFECT OF THERMOCOUPLE SIZE AND INSTALLATION ON TEMPERATURE READINGS
Noah J. Hurst 8 Apr. 1964 21 p
(RS-TM-64-1; AD-612493)

The temperature readings of a thermocouple are reliable if the entire hot junction of the thermocouple is maintained at a steady temperature and there is good physical contact between the thermocouple junction and the surrounding material. However, if a large temperature gradient exists around the junction, or if the temperature varies with time, the thermocouple readings may be questionable. Thermocouples using two wire sizes were installed on copper and aluminum plates and arranged under a bank of quartz lamps. The heating to the plates was at two levels of heat flux and each plate was

exposed in two positions. For the heat fluxes, wire sizes, and installations investigated, no significant difference in temperature readings was observed. E.W.

N65-20532# Naval Ordnance Lab., White Oak, Md. Environment Simulation Div.
HAND-HELD SHOCK TESTER WOX-6A
John E. Messner 29 Oct. 1964 39 p refs
(NOLTR-64-203; AD-613020)

A 5.1-lb shock tester the size of a hand tool is described. For items the weight of piezoelectric accelerometers, the tester produces shock pulses ranging from 400 g to 1000 g peak with durations of 1 msec and velocity changes up to 15 fps. In operation, two 6.2-oz, constant-load spring motors accelerate a small, 77.5-gram test vehicle and payload down a 6-in. barrel at a maximum impact velocity of 10 fps. Impact is against a thin rubber disk bonded to a high-impact nylon plastic spring. The hand grip of the tester makes up 80% of the tester weight and is the reaction mass for the shock vehicle. Author

N65-20597# Edgerton, Germeshausen and Grier, Inc., Boston, Mass.
[PARTIAL PREPROTOTYPE DIRECT VIEW OPTICAL DETECTION SYSTEM] Second Quarterly Report, 1 Nov. 1963–31 Jan. 1964
Lawrence B. Woolaver 30 Apr. 1964 50 p
(Contract AF 33(657)-12291)
(B-2763; AD-440016)

The evaluation program for photomultiplier tubes and photovoltaic cells was completed. Design specifications for the system were developed, and a detector design employing silicon photovoltaic cells was initiated. Also, the electronic design of the system was partially completed. A preliminary block diagram of the partial preprototype detection systems, showing the flow of signal information from the detectors through the video gate portion of the logic to the display and record units, is presented. E.E.B.

N65-20611# Ling-Temco-Vought, Inc., Dallas, Tex. LTV Astronautics Div.
EXPERIMENTAL INVESTIGATION OF OPTICAL PRESENTATION OF THREE-DIMENSIONAL DISPLAY Final Report
Eugene Lankford 6 Jan. 1965 75 p refs
(Contract Nonr-4439(00))
(Rept.-00.567; AD-610150)

The objective was to design and develop two experimental prototypes of a volumetric three-dimensional display utilizing point-light images generated by cathode ray tubes, which are seen by an observer located in the real image field of a parabolic and plane mirror. Various approaches of image combining such as time-sharing and light-sharing were investigated. The investigation resulted in the verification of the feasibility of the 3-D display concept. Both light-sharing and time-sharing of multiple image presentations are possible means of reproducing images in three dimensions. The choice of method is predicated on the specific application. The utilization of three dimensional presentation is restricted only by the quality of the data received for presentation, quality of the optic-electro-mechanical system and functional space. Recommendations for additional investigation as a continuation of this study are: investigation of vision threshold and fusion frequencies below 5 μsec regime, and continuation of the development of uses of cathode ray tube image production technique to present 3-D information with time and/or light sharing methods. Author

N65-20649# Royal Aircraft Establishment, Farnborough (England).
THE DESIGN OF ELECTROMAGNETIC GALVANOMETERS FOR PHOTOGRAPHIC RECORDING OF DYNAMIC EFFECTS
E. C. Voss London, Min. of Supply, Nov. 1947 26 p ref
(RAE-TN-INSTN-115)

The electrical, magnetic, mechanical, and optical factors involved in the design of electromagnetic vibration galvanometers used in oscillographic recording are discussed. Various types are considered, and their relative advantages and disadvantages are assessed. Two recent British designs are considered. Author

N65-20655*# Raytheon Co., Norwood, Mass. Communications and Data Processing Operation
FAST SCAN INFRARED DETECTION AND MEASURING INSTRUMENT Monthly Progress Report, Oct. 1–31, 1964
R. Vanzetti, P. Chunko, and G. Mathis 16 Nov. 1964 8 p
(Contract NAS8-11604)
(NASA-CR-57593) CFSTI: HC $1.00/MF $0.50

Quality profile analysis of the optical system disclosed excessive blur circle diameters when off-axis distances of 0.5 mm were required. A refractive element was introduced to minimize this effect and to achieve an effective spot diameter of 0.003-inch maximum across field. Introduction of this element limits space allotted to scan system insertion to about 5 inches along beam axis between refractive element and detector aperture. Design compatibility with the optical system has fixed the detector aperture dimensions at 0.0762-mm minimum diameter and divergency angle at 3°19′. With the exception of circuit details of the logarithmic preamplifier between detector and voltage amplifier, and the built-in test circuits, the electrical design is complete. E.E.B.

N65-20679# Royal Aircraft Establishment, Farnborough (England)
SOME SOURCES OF ERROR IN THE TUNING FORK GYROSCOPE
A. E. W. Hobbs London, Min. of Aviation, Apr. 1962 60 p refs
(RAE-TN-IAP-1139)

The mode of operation of a gyroscope using the vibrations of a tuning fork to detect axial rotation in space is described. Details are given of an experimental instrument of this type with which this note is concerned. Equations are derived showing how steady-state errors in the output signal obtained from the instrument can occur, and the experimental verification of this theory is described. A balancing technique to minimize these errors is suggested. It is shown how these steady error signals can change with the magnitude and direction of applied acceleration. An experimental analysis of the changes in error signal with instrument attitude is described together with a balancing procedure for the adjustment of certain of these variations. Improvements in design are suggested for incorporation in future instruments to enable some unexplained changes of error signal with attitude to be investigated. Author

N65-20743# Royal Aircraft Establishment, Farnborough (England).
A RESOLVED COMPONENTS INDICATOR WITH FACILITIES FOR EXTERNAL RECORDING
D. J. Miles London, Min. of Aviation, Jun. 1962 24 p refs
(RAE-TN-IAP-1144)

A laboratory instrument for resolving a sinusoidal voltage in the frequency range 300 to 2000 cps into components which are in phase with and in quadrature to a fixed external reference of 0.1 to 10 V rms is described. Outputs proportional to the components are provided for the instrument meters and external pen recorders, full-scale meter deflection being obtainable for signals from 1 mV to 10 V rms. For signals greater than 10 mV the accuracy of phase resolution is ±0.1°; amplitude measurement is made within ±0.2%. Semiconductor devices are used throughout. Author

N65-20754*# Eppley Lab., Inc., Newport, R. I.
DUMMY MOCK-UP PHASE SOLAR SPECTRAL MEASUREMENT PROGRAM Final Technical Report
A. J. Drummond 28 Dec. 1964 50 p Prepared for JPL
(Contracts NAS7-100; JPL-950929)
(NASA-CR-57720) CFSTI: HC $2.00/MF $0.50

Design and testing of a dummy mockup of a device for solar measurements are presented in detail. The mockup was constructed from a solid block of magnesium, and consisted of two single-channel modules made of anodized aluminum and a unit of 12 channels. Material and function of the detectors, lenses, and filters are discussed. Test data include results of spectrophotometric examination and transmittance of the narrow bandpass filters, mechanical shock, uv solarization, thermal shock on filtered and unfiltered channels, channel sensitivity, and detector signal amplification in the single-channel modules. J.M.D.

N65-20773# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research
REACTOR DETECTORS DEVELOPED SINCE 1963
Jadwiga Jablonska, Andrzej Janikowski, and Jerzy Topa Nov. 1964 23 p ref
(Rept.-561/IXA)

New types of detectors developed for reactor control systems and for some measurements in reactor physics are described. These are the pulse fission chamber with uranium 235; boron ionization chambers, compensated for gamma radiation and uncompensated; threshold fission chambers with thorium 232; and small ionization chambers for gamma scanning. The construction of the detectors is shown, and the main parameters are given. Author

N65-20792*# Santa Barbara Research Center, Goleta, Calif.
35-ELEMENT COLD GAS-COOLED ARRAY Final Report
J. P. Long 10 Mar. 1965 19 p Prepared for JPL
(Contracts NAS7-100; JPL-950962; SBRC Proj. 5778)
(NASA-CR-57757) CFSTI: HC $1.00/MF $0.50

The optical design of a silicon front lens and a strontium titanate lens with an immersed PbSe detector for −80° C and warmer operation is described. Characteristics of the thermo-ribbon sensors, spectral filter, and detector–filter are included. Also, test procedures and detector performance data are presented. E.E.B.

N65-20814*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
CURRENT RESEARCH ON ADVANCED COCKPIT DISPLAY SYSTEMS
Roger L. Winblade Washington, NASA, [1964] 25 p refs Presented at the 25th Flight Mech. Panel Meeting of AGARD, Munich, 12–14 Oct. 1964
(NASA-TM-X-56010) CFSTI: HC $1.00/MF $0.50

Current cockpit-display philosophy is discussed in terms of the pilot's informational requirements. Pilots' scan patterns obtained through the use of an eye-position camera and a ground-based simulator are depicted for a conventional display system and for two advanced concepts. Preliminary results of some flight-test and ground-simulation evaluations of advanced concepts are discussed. Author

N65-20857# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STELLAR PHOTOMETER AND SPECTROMETER FOR THE 1–2.5 MICRON RANGE
V. I. Moroz 3 Dec. 1964 16 p refs Transl. into ENGLISH from Novaya Tekhn. v Astron.: Materialy Soveshch. 1961 g. Astron. Sov., Akad. Nauk SSSR (Moscow), 1963 p 149–156
(FTD-TT-64-369/1+2; AD-609915)

A stellar photometer and an infrared spectrometer, with which the Crab Nebula flux in the range of 1 to 2.5 microns was measured and the spectrum of the night sky radiation was investigated, are described. In the two instruments, identical receiving and amplifying equipment was used. Radiation receivers of two types were used: a lead-sulfite photoresistor, and a germanium valve photoelement. Both operated at the temperature of dry ice. Detailed characteristics for the instruments and the results obtained are presented. Also, the circuit diagram and a discussion of basic principles are included. E.E.B.

N65-20874# National Cash Register Co., Dayton, Ohio. Research Div.
THEORY, DESIGN, AND OPERATION OF A HIGH VACUUM ELLIPSOMETER Interim Engineering Report, 1 Jan. 1963–30 Jun. 1964
F. G. Ullman, D. Churchill, and L. E. Blakely, Jr. Mar. 1965 128 p refs
(Contract AF 33(657)-10459)
(IER-1; AD-460166)

A high-vacuum ellipsometer was designed and constructed for the determination of the thickness of transparent films on reflecting substrates with a precision of ±1 Å or better. A discussion of ellipsometry theory and technique is given, and the design of the instrument is described in detail. A detailed optical alinement procedure for this instrument is included. Author

N65-20899# General Motors Corp., Santa Barbara, Calif. GM Defense Research Labs.
THE DIAGNOSTIC APPLICATIONS OF MICROWAVE ABSORPTION AND DISPERSION
I. P. French Jan. 1965 20 p refs
(Contract DA-01-021-AMC-11359(Z); ARPA Order 347, Proj. Defender)
(TR65-01D; AD-459651)

The possibility of measuring species concentration in high-temperature air by microwave spectroscopy is considered. The species selected are molecular oxygen, which has transitions in the region from 52 to 68 Gc, and nitric oxide with transitions around 150 Gc. The feasibility appears marginal, but this evaluation is based on many approximations and assumptions, and further work is required for definitive conclusions. Author

N65-20916# Naval Radiological Defense Lab., San Francisco, Calif. Nucleonics Div.
A GAMMA-RAY DIGITAL DOSIMETRY SYSTEM
R. A. Taylor 12 Jan. 1965 19 p refs
(USNDRL-TR-807; AD-459457)

A digital dosimeter system employing a scintillation detector and an analog to digital converter was designed and constructed for the measurement of gamma-ray differential dose. The differential dose for gamma rays with energies up to 700 keV, and dose rates as low as 0.2 mr/hr, have been measured to better than ±11% with this instrument. The limitation on the accuracy of the electronics is of the order of ±1%. Author

N65-20917# Naval Radiological Defense Lab., San Francisco, Calif. Nucleonics Div.
SELF-NORMALIZATION OF SPACEBORNE RADIATION-MEASURING INSTRUMENTS
W. F. Joseph 12 Jan. 1965 35 p refs
(USNRDL-TR-809; AD-459407)

The calibration requirements of remotely operated spaceborne radiation-measuring instruments are discussed, including factors responsible for errors and malfunctioning. Remotely operated instruments require periodic checking and calibration to insure accuracy of data and to determine whether performance is normal. Two general types of automatic checking are possible: (1) automatic calibration systems which make periodic calibration checks, the results of which are sent to the ground station for subsequent data correction; and (2) self-normalization systems which not only automatically calibrate but also automatically readjust instruments. All calibration methods require the use of standard-signal sources. For radiation-measuring instruments these may be radioisotope sources, light sources (for scintillation systems), or voltage, current or pulse sources. Each of these standard source types is discussed in regard to application, characteristics, and mode of operation. Author

N65-20951# Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf (Austria). Institut für Electronik
AUTOMATIC MEASURING AND DEMAGNETIZING EQUIPMENT FOR THE SIEGBAHN-SLATIS BETA-RAY SPECTROMETER [AUTOMATISCHE MESS- UND ENTMAGNETISIERUNGS-EINRICHTUNG FUR DAS SIEGBAHN-SLATIS ZWISCHENBILD BETA-SPEKTROMETER]
F. May [1965] 13 p ref *In* GERMAN; ENGLISH summary
(SCAE-E-1/1964)

An automatic control system for the Siegbahn–Slätis β-ray spectrometer is described, similar to that described by Konopasek and Connor. In addition, a system for automatic demagnetization is included, with emphasis on the simplicity of the stepping device. The whole system has been running since the summer of 1962, with only minor defects. Author

N65-20956# Naval Radiological Defense Lab., San Francisco, Calif.
FACTORS IN CALIBRATION OF SPACE RADIATION MEASURING SYSTEMS
C. F. Ramstedt 1 Jan. 1965 59 p refs
(USNRDL-TR-812; AD-459458)

Criteria for the development of improved calibration methods for space radiation measuring systems were established. Instrument calibration will depend on the specific application and vehicle, and must consider detector sensitivity for each type of radiation present as a function of energy, direction, and intensity of the radiation fields. Development of methods should emphasize GM tubes and solid-state detectors initially, because of their predominant use in satellites. Graphical summaries of the intensities of the trapped particles as a function of energy have shown that calibration routines may require exposure of detectors to electrons from 40 keV to 10 meV and protons from under 1 to over 500 MeV, with intensity ranges in excess of 4 decades at all energies. Radiation sources capable of simulating the majority of trapped proton and electron fields are available. Also, an initial survey of the nonradiation environment has resulted in sufficient data for the specification of a temperature-controlled vacuum test chamber, suitable for this work. Author

N65-20975 General Precision, Inc., Binghamton, N. Y. Systems Div.
AUTOMATIC POINT MARKING MEASURING AND RECORDING INSTRUMENT Final Technical Report, 31 Mar. 1961–31 Aug. 1964
M. Allen, E. Paufve, I. Shim, R. Woodson 23 Dec. 1964 35 p
(Contract DA-44-009-ENG-4775)
(Rept.-645; AD-610044)

This report covers the development of the automatic point marking measuring and recording instrument (APMMRI). A summary is presented which describes the purpose of the program and the results of the effort expended. The report describes the general operation and content of the various subsystems and includes illustrations. Some of the techniques and approaches investigated are discussed with particular emphasis on the schemes finally chosen. The report concludes with a complete and thorough list of comments and recommendations for improvements and extended capabilities for future generations of the APMMRI. Author

N65-20977*# Texas Univ., Dallas. Dept. of Pathology
INFLUENCE OF GRAVITY ON UNICELLULAR ORGANISMS Progress Report, Dec. 1, 1961–May 1, 1962
[1962] 2 p
(Grant NsG-210-62)
(NASA-CR-57792) CFSTI: HC $1.00/MF $0.50

A scanning microscopy system is described for study of samples of unicellular organisms. In this system the scanning beam focuses on a spot on the scanner tube face and remains stationary until a preassigned amount of information is collected. Calculations indicate that this system is capable of yielding high signal-to-noise ratios. Preliminary apparatus was constructed which will analyze 100 000 picture points in the microscopic field. Also, various objectives of ultraviolet transmitting optics are discussed with respect to suitability for use in flying spot scanning systems. Ultraviolet emitting phosphors and display tube design projects are reported briefly. J.M.D.

N65-20986*# National Aeronautics and Space Administration, Washington, D. C.
MEASUREMENT OF THE MICROSTRUCTURE BY THE METHOD OF SMALL ANGLES [IZMERENIYA MIKROSTRUKTURY METODOM MALYKH UGLOV]
K. S. Shifrin and V. I. Golikov Apr. 1964 21 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 152, 1964 p 3–15
(NASA-TT-F-317) CFSTI: HC $1.00/MF $0.50

The article discusses the results of testing a prototype of a field device for measuring the microstructure of fogs by the method of small angles. Author

N65-20988*# National Aeronautics and Space Administration, Washington, D. C.
COMPUTATION OF A HEMISPHERICAL RADIATOR FOR CALIBRATING PYRGEOMETERS [RASCHET POLUSFERICHESKOGO IZLUCHATELYA DLYA GRADUIROVKI PIRGEOMETROV]

T. D. Voytikova Apr. 1965 14 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 152, 1964 p 160–167
(NASA-TT-F-326) CFSTI: HC $1.00/MF $0.50

Calculations are presented for (1) the radiation coefficients of a black hemispherical radiator for various ratios of the radius of the hemisphere to the diameter of the radiating aperture, and (2) various coefficients of blackness of the internal cavity surface. An investigation was made of the effect of the device on the radiation coefficient of the cavity, and errors that occur because of the inaccurate measurement of the surface temperature. Author

N65-21031# Northrop Space Labs., Hawthorne, Calif.
RESEARCH ON X-15 BACKGROUND MEASUREMENTS Interim Engineering Report, 1 Oct. 1964–20 Mar. 1965
R. H. Bingham 23 Mar. 1965 15 p
(Contract AF 33(615)-1566)
(IER-2; AD-460464)

The modification of the extended range X-15 mounted spectrometer was completed. The instrument was subjected to environmental testing during which there was one component failure. Upon repair the instrument passed the tests satisfactorily. The instrument was adjusted, calibrated, and installed in the X-15 ship. E.E.B.

N65-21041# Massachusetts Inst. of Tech., Cambridge. Lab. for Insulation Research
ELECTRON-IONIZATION CROSS SECTIONS Semiannual Progress Report, Jun. 15–Dec. 15, 1964
[1964] 16 p refs
(Contract AF 33(657)-10939)
(SAPR-3; AD-613073)

The wire-wound ionization-chamber technique was given its initial tests; performance was satisfactory. Two electron monochrometers were constructed. The design and procurement of a new set of standard parts was completed. Ionization cross-section measurements for titanium were initiated. Author

N65-21049# Massachusetts Inst. of Tech., Cambridge. Lab. for Insulation Research
DEVELOPMENT OF A QUADRUPOLE MASS SPECTROMETER Technical Report No. 194
C. E. Woodward and C. K. Crawford Dec. 1964 59 p refs
(Contracts AF 33(616)-8353; AF 33(657)-10939)
(AFML-TR-64-400; AD-610100)

The electric quadrupole mass spectrometer developed covers 1 to 400 amu in four ranges. The electronic circuits that supply voltages to the mass filter are capable of 50:1 spectral-range sweeps in 0.1 sec, but resolution over a wide sweep range is limited by nonlinearity in the control of the rf voltage. Compensation reduces nonlinearity over a 10:1 sweep range from 4% to 0.4%. The electron-multiplier ion collector is operated as a particle detector to eliminate the effects of multiplier gain variations. High-speed circuits (resolving times $< 5 \times 10^{-8}$ sec) produce standard output pulses that are integrated in a linear ratemeter to determine the mean rate. Spectrometer resolution is limited by mechanical imperfections in the quadrupole lens: The highest observed value has been $m/\Delta m = 300$ measured at the 1% amplitude points. A fine structure on the mass lines is attributed to lens imperfections. Author

N65-21056 Bell Helicopter Co., Fort Worth, Tex.
CONTACT ANALOG SIMULATOR EVALUATIONS: VERTICAL DISPLAY WITH HORIZONTAL MAP DISPLAY
J. H. Emery and D. J. Dougherty Oct. 1964 46 p refs
(Contract Nonr-1670(00))
(D228-421-020; AD-612465)

Evaluation was made of the pilot's ability to navigate and perform simulated helicopter terminal area maneuvers using contact analog vertical display symbology alone and in the presence of the horizontal map display. Combinations of the grid, flight pathway and ground position indicator (GPI) on the vertical display with and without the map display were investigated. Performance measures were taken of the terminal area maneuvers including the landing approach, transition to hover, hover, and touchdown. Performance on the approaches and transition to hover scores indicated improved performance with the additional information provided by the pathway and the GPI. Precision of performance could be improved with the pathway and GPI navigation features on the vertical display but successful accomplishment of terminal area maneuvers was not entirely dependent upon this information. Author

N65-21096 Cutler-Hammer, Inc., Deer Park, N. Y. Airborne Instruments Lab.
SOLID-STATE FERROELECTRIC ACCELEROMETER Interim Report, 4 Aug.–4 Dec. 1964
A. Goldstein, S. H. Gross, A. Hebling, and H. Levenstein 14 Dec. 1964 30 p refs
(Contract NOw-64-0093-c)
(IR-4; AD-455352)

Effort was concentrated on obtaining a more reliable experiment and readout system. The continued search for appropriate materials resulted in the acquisition and listing of several polyurethanes. Author

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N65-20123# Waterloo Univ. (Ontario). Mechanical Engineering Dept.
CONTOURED BRANCH PIPE CONNECTIONS. THICK-WALLED BRANCH PIPE CONNECTIONS
E. Siebel, S. Schwaigerer, K. Wellinger, E. Krägeloh, and G. Beckmann [1964] 88 p refs

CONTENTS:

1. INVESTIGATIONS INTO THE STRENGTH OF CONTOURED BRANCH PIPE CONNECTIONS E. Siebel and S. Schwaigerer p 1–55 (See N65-20124 10-15)
2. INTERNAL PRESSURE EXPERIMENTS ON THICK-WALLED BRANCH PIPE CONNECTIONS K. Wellinger, E. Krägeloh, and G. Beckmann p 56–83 refs (See N65-20125 10-15)

N65-20124 Waterloo Univ. (Ontario). Mechanical Engineering Dept.
INVESTIGATIONS INTO THE STRENGTH OF CONTOURED BRANCH PIPE CONNECTIONS

E. Siebel and S. Schwaigerer *In its* Contoured Branch Pipe Connections. Thick-Walled Branch Pipe Connections [1964] p 1–55 (See N65-20123 10-15)

In order to obtain a picture of the stresses in collared branch pipes, and data for the strength calculations, deformation measurements were made on such pipes. The maximum strains in unreinforced branch pipes were always found in the longitudinal cross section in the immediate vicinity of the collar in the circumferential direction of the main pipe. A method for the calculation of desired wall thickness of the main pipe or for the calculation of permissible internal pressure is given. The lowering of stresses at the maximum stressed points through a welded saddle-shaped reinforcing strip and the application of plane reinforcing bows welded to the main pipe at the ends are also discussed. Also, the stress behavior of oblique branch pipes was investigated. E.E.B.

N65-20125 Technische Hochschule Stuttgart (West Germany).
INTERNAL PRESSURE EXPERIMENTS ON THICK-WALLED BRANCH PIPE CONNECTIONS
K. Wellinger, E. Krägeloh, and G. Beckmann *In* Waterloo Univ. Contoured Branch Pipe Connections. Thick-Walled Branch Pipe Connections [1964] p 56–83 refs (See N65-20123 10-15)

Experiments to obtain the pressures at which there is 0.2% plastic deformation at the maximum stressed point of thick-walled pipes with right-angled single branch pipes of various forms and dimensions and to obtain the weakening factor as a basis for design are reported. It was shown that the pressure at which there is 0.2% plastic deformation inside the pipe can be obtained from externally measured values. However, this is dependent on accurate strain measurement for which the beginning of flow on the inside can be accurately ascertained. Furthermore, the measurements showed that the limiting pressure which produces 0.2% plastic deformation on the outside cannot be used for the inside values for thick-walled pipes, although this method can be used for thin walled vessels. Hence, values for thin-walled pipes are not valid for thick-walled piping. E.E.B.

N65-20195# Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (West Germany). Institut für Flugzeugbau
THE BEHAVIOR OF METAL-BONDED JOINTS UNDER TEMPERATURES BETWEEN +20°C AND +400°C [DAS FESTIGKEITSVERHALTEN VON METALLKLEBVERBINDUNGEN IM TEMPERATURBEREICH VON +20°C BIS +400°C]
W. Althof Dec. 1964 88 p refs In GERMAN; ENGLISH and FRENCH summaries Sponsored by Deut. Forschungsgemeinschaft
(DLR-FB-64-41) Munich, ZLDI: 13 DM

Metal-bonded joints with organic high temperature stable adhesives were tested at temperatures up to +400° C. These tests concern single lap joints, butt joints, and bonds for T-peeling tests. As material for the adherends, aluminum alloys and stainless steel were used. At temperatures above +100° C and long-time influence, the bond strength decreases. Bonds of stainless steel are thereby less favorable than bonds of aluminum alloys. At a temperature of +250° C, a short-time heat loading of 3 min results in a decrease of the bond strength of 20% to 80%, depending on the shape of the bonding joint. Author

N65-20201# Joint Publications Research Service, Washington, D. C.
STUDIES IN THE BRAZING AND SOLDERING OF METAL ALLOYS
2 Mar. 1965 27 p refs Transl. into ENGLISH of 3 Articles from Russian Publ.
(JPRS-28946; TT-65-30414) CFSTI: $2.00

CONTENTS:

1. SOLDERING OF ALUMINUM TO STEEL V. R. Ryabov and Ye. O. Paton p 1–8 refs (See N65-20202 10-15)

2. INTERACTION OF SOLDER WITH THE MATERIAL BEING SOLDERED 2. DISSOLUTION OF BASE METAL DURING SOLDERING N. F. Lashko and S. V. Lashko p 9–19 refs (See N65-20203 10-15)

3. INVESTIGATION OF DIFFUSION PROCESSED IN THE BRAZING OF TITANIUM ALLOYS A. Ya. Shinyayev and V. V. Bondarev p 20–24 refs (See N65-20204 10-15)

N65-20202 Joint Publications Research Service, Washington, D. C.
SOLDERING OF ALUMINUM TO STEEL
V. R. Ryabov and Ye. O. Paton *In its* Studies in the Brazing and Soldering of Metal Alloys 2 Mar. 1965 p 1–8 refs Transl. into ENGLISH from Mashinostr. (Kiev), no. 6, 1962 p 53–56 (See N65-20201 10-15) CFSTI: $2.00

Methods of soldering aluminum and its alloys to steel are surveyed. Difficulties in soldering aluminum to steel, due to differences in their physicochemical characteristics, are discussed. A number of soldering methods are outlined, most of which involve prior coating of the aluminum or steel—or both—surfaces with flux metals such as tin, zinc, or copper; the metallic composition of the solder is given for each procedure. An ultrasonic soldering method is described. J.M.D.

N65-20203 Joint Publications Research Service, Washington, D. C.
INTERACTION OF SOLDER WITH THE MATERIAL BEING SOLDERED. 2: DISSOLUTION OF BASE METAL DURING SOLDERING
N. F. Lashko and S. V. Lashko *In its* Studies in the Brazing and Soldering of Metal Alloys 2 Mar. 1965 p 9–19 refs Transl. into ENGLISH from Avtomat. Svarka (Kiev), 1963 p 30–35 (See N65-20201 10-15) CFSTI: $2.00

A study was made of the dissolution of pure metals in more readily fusible liquid metals (solders) under the conditions approximating those of capillary soldering and soldering in a bath. Rate of dissolution with rising temperature depends on the amount of solder and structure of the alloy that is formed in the soldered seam and the zone of diffused interaction. Formation of interlayers of incongruent chemical compounds at the contact of liquid solder with the metal being soldered decreases the rate of its dissolution near the peritectic temperature. Ways of lowering the rate of dissolution of the metal being soldered in the liquid solders are considered. Author

N65-20204 Joint Publications Research Service, Washington, D. C.
INVESTIGATION OF DIFFUSION PROCESSED IN THE BRAZING OF TITANIUM ALLOYS
A. Ya. Shinyayev and V. V. Bondarev *In its* Studies in the Brazing and Soldering of Metal Alloys 2 Mar. 1965 p 20–24 refs Transl. into ENGLISH from Tr. Inst. Met. Akad. Nauk SSSR (Moscow), no. 12, 1963 p 121–124 (See N65-20201 10-15) CFSTI: $2.00

A brazing process for joining titanium to other metals is reported. The process is based on a coating of nickel–cobalt which is electroplated between the titanium and the braze. This coating has the properties of preventing oxidation of the titanium during brazing and its interaction with the braze. Temperature of the process must allow formation of a diffusion zone having thickness of 7 to 12 microns, and the zone must be a solid solution of the titanium and the coating. The process was successfully applied to various titanium alloys. J.M.D.

N65-20240# International Business Machines Corp., Kingston, N. Y. Data Systems Div.
TERMINAL REPORT FOR PERCUSSIVE WELDING STUDY II
E. G. Law and S. J. Szabronski [1964] 227 p
(Contract N163-11815(X)(FBM))
(AD-610148)

Terminal end welding is the concept of welding a wire, or wires, to the top surface or head of a terminal (such as the common straight pin). This study was proposed since, if successful, back panel wire length could be reduced by going directly from pin to pin; pin density might be increased if there were a limited number of wires per terminal; and the ultimate welding head could be more simple than that for side pin welding. This report discusses laboratory tests on the weld joints, and the fabrication of a small panel with end welded terminations on a grid spacing of 0.100 × 0.100 inch. Author

N65-20400# Horizons, Inc., Cleveland, Ohio.
DEVELOPMENT OF CONTINUOUS-TONE FREE-RADICAL REPRODUCTION MATERIALS Final Report, 18 Apr. 1963–7 Jun. 1964
R. H. Sprague and M. Roscow Nov. 1964 123 p
(Contract AF 33(657)-11647)
(SEG-TR-64-64; AD-609950)

Effort was directed toward the production of machine-coated film of free-radical photographic materials suitable for the reproduction of high-acuity continuous-tone reconnaissance negatives through several generations. Satisfactory machine-coatings, approximately 9-1/2 inches wide in 1000-foot lengths, were made of the DPA blue-image formulation and of the SQ/D-177 black-image photosystem. With these films, fourth-generation prints (with near-unity contrast and gamma) were achieved from aerial negatives of high, medium, or low contrast. Gamma-tonal response was controlled by variation of the spectral quality of the exposing light and exposure time. A laboratory coating machine was acquired.
Author

N65-20487*# Electro-Optical Systems, Inc., Pasadena, Calif.
DEVELOPMENT OF COMPOSITE IONIZER MATERIALS Final Report
M. La Chance, B. Thompson, H. Todd, and G. Kuskevics 8 Apr. 1965 152 p refs
(Contract NAS3-5248)
(NASA-CR-54188; EOS-4970-Final) CFSTI: HC $5.00/MF $1.00

Research to improve the pore structure, thermal stability, and performance of tungsten ionizers was conducted by adding secondary elements to tungsten microspheres by metal particle addition, vapor deposition of metal films, and hydrogen reduction of inorganic compounds. A composite powder mixture can exhibit very good dimensional stability during sintering at 2000° C, yet can result in an ionizer having a very coarse sintered pore structure, and markedly reduced ionization performance. Therefore, the diffusion mechanisms during sintering have a direct and important influence on ionizer pore structures and subsequent performance. Based on total consideration of characteristics, W-7A/oTa (fabricated for metal particle mixture) is recommended as the best ionizer composition for long-time operation. Author

N65-20556# Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center
STUDY OF THE FEASIBILITY OF APPLYING ULTRASONIC ENERGY TO THE ROLLING PROCESS FOR SHEET METALS Final Report
James W. Cunningham and Ronald J. Lanyi 15 Mar. 1965 117 p refs
(Contract NOw-0294-j)
(AD-612480)

The application of 10- to 20-kc acoustic energy during the rolling of metal sheet was investigated. The considerable theoretical potential of both the volume and surface contributions of ultrasound to rolling is described, particularly with respect to sheet thickness. The importance of the relative directions of vibrational displacement, deformation force, and metal flow is pointed out. A series of rolling experiments in which a magnetostrictive transducer was attached to the workpiece is described, and load reductions on the order of 5% attained during these experiments related to the acoustic parameters. A roll design incorporating an ultrasonic transducer in the interior of the roll was formulated and constructed. The extensive electromechanical problems encountered during roll construction are described. These problems were only partially solved and the resultant rolls had a very short life, although load reductions of 5% were obtained on several materials. Author

N65-20570# National Research Council of Canada, Ottawa (Ontario).
QUARTERLY BULLETIN OF THE DIVISION OF MECHANICAL ENGINEERING AND THE NATIONAL AERONAUTICAL ESTABLISHMENT, 1 JULY TO 30 SEPTEMBER 1964
[1964] 96 p refs
(DME/NAE-1964(3))

CONTENTS:

1. LOW TEMPERATURE CHARACTERISTICS OF MULTIPURPOSE GEAR OILS R. B. Whyte p 1–14 refs (See N65-20571 10-15)
2. PHOTOGRAMMETRIC CHECKING OF WIND TUNNEL MODELS A. J. Bowker p 15–43 (See N65-20572 10-15)
3. CURRENT PROJECTS OF THE DIVISION OF MECHANICAL ENGINEERING AND THE NATIONAL AERONAUTICAL ESTABLISHMENT p 45–87

N65-20571 National Research Council of Canada, Ottawa (Ontario). Fuels and Lubricants Lab.
LOW TEMPERATURE CHARACTERISTICS OF MULTIPURPOSE GEAR OILS
R. B. Whyte *In its* Quart. Bull. of the Div. of Mech. Eng. and the Natl. Aeron. Estab., 1 Jul. to 30 Sep. 1964 [1964] p 1–14 refs (See N65-20570 10-15)

The performance of four multipurpose gear oils in laboratory bench tests, in differential assemblies in the cold room, and in the same vehicle differential is reported. It was concluded: (1) At the low ambient temperatures at which 75 grade oils are used, the chemical activity of the E. P. additives is too low to prevent surface damage to the gear teeth under severe conditions. An increase in additive content of 25% over that

used in the higher grades is sufficient to give satisfactory protection. (2) Excellent correlation was obtained between channel points and the temperature at which the oil begins to seriously affect the torque required to turn a differential assembly. (3) There was no evidence that prolonged storage at low temperatures results in torque requirements greater than storage overnight. (4) The original Army recommendations for changing from 90 to 75 grade lubricants in rear axles at about +32° F ambient did not agree with either these findings or with commercial practice. Change should be made at 0° to −10° F. E.E.B.

N65-20572 National Research Council of Canada, Ottawa (Ontario).

PHOTOGRAMMETRIC CHECKING OF WIND TUNNEL MODELS

A. J. Bowker *In its* Quart. Bull. of the Div. of Mech. Eng. and the Natl. Aeron. Estab., 1 Jul. to 30 Sep. 1964 [1964] p 15–43 (See N65-20570 10-15)

After a short description of the attractions, possibilities, and simplified principles of using photogrammetric techniques to measure wind tunnel models or other complex surfaces, a specially designed system for that purpose is presented. Three stations on both sides of a 30-in. root chord 70-degree delta-wing model were measured on a precision (±0.00015-in) jig borer and by photogrammetric means. The results indicated that, although more work remains in determining lens errors, the photogrammetric method looks very promising. The main attraction of photogrammetric checking is the accuracy expected (±0.001 in.) by an absolute measuring system independent of the manufacturing processes. Also, for smaller areas, other systems may be designed to give proportionately greater accuracy. Author

N65-20619# Union Carbide Corp., Lawrenceburg, Tenn. Advanced Materials Lab.

DEVELOPMENT OF GRAPHITE-BASE REFRACTORY COMPOSITES WITH OXIDATION RESISTANCE AT VERY HIGH TEMPERATURES

Karl J. Zeitsch [1964] 15 p refs Presented at the 8th Meeting of the Refractory Composites Working Group, Fort Worth, Tex., 14–16 Jan. 1964 Sponsored by AF

Using two devices specifically designed to measure oxidation resistance of graphite-base refractory composites at high temperatures, the possibility of further extending the usefulness of these composites to 2000° C and above is demonstrated. The first measuring apparatus levitates the sample by the combined action of aerodynamic and electromagnetic forces. The electromagnetic forces stem from the induction coil which also accomplishes the heating, and uniformity of oxidation is insured by tilting the induction coil to rotate the sample electromagnetically. The apparatus can be used from the low threshold temperatures of optical pyrometry to over 2000° C. The second device is a torsional effusion apparatus which operates on the principal that if the area of the hole in each effusion cell is small as compared with the area of the entire cell interior, and if the release of gas from a reaction inside each effusion cell results in an efflux having molecular flow characteristics, then the resulting torque is proportional to the partial pressure developed by the given reaction in the cells. M.P.G.

N65-20661# Royal Aircraft Establishment, Farnborough (England).

A DIGITAL RECORDING SYSTEM FOR STRUCTURAL RESEARCH

D. Purslow London, Min. of Aviation, Aug. 1964 77 p refs (RAE-TN-STRUCT-365)

The recording system described measures the output of strain gage bridges, displacements by determining the position of potentiometer wipers, temperature by use of chromel–alumel thermocouples, and the millivolt output of any dc transducer. The measurements are recorded on punched cards and in typescript. The methods used to measure the different types of transducer signal are surveyed, and detailed operating procedures are given. Author

N65-20666# Royal Aircraft Establishment, Farnborough (England).

INTERIM NOTE ON USAF-SwRI AEROSPACE BEARING CONFERENCE, MARCH 25TH–27TH, GRANADA HOTEL, SAN ANTONIO, TEXAS

G. H. Kinner London, Min. of Aviation, May 1964 15 p (RAE-TN-CPM-75)

Reports are summarized on bearings and lubrication for aerospace applications. The papers are grouped under five headings: fundamentals, lubricating materials, rolling element bearings, gas and unconventional bearings, and state-of-the-art appraisal. Topics concern solid film and gas lubricants, friction and evaporation, ball bearings, and testing of bearings and lubricants under space-simulation conditions of vacuum or of high pressure and temperature. J.M.D.

N65-20695# California Univ., Livermore. Lawrence Radiation Lab.

AN EXPLOSIVELY DRIVEN PIPE CLOSURE

Donald H. Gipson 15 Feb. 1965 11 p
(Contract W-7405-ENG-48)
(UCRL-12203) CFSTI: $1.00

An explosively driven pipe closure was designed. It is an 8-foot-long, 6000-pound, hollow steel cylinder having an inner bore of 9-1/2 in. and an outer diameter of 18 in. A laminate charge of high explosives drives a portion of the wall thickness radially inward to form a solid rod of steel centered on the original long axis of symmetry. This solid rod is approximately 10 in. in outer diameter by 40 in. in length. The closure operation is completed within a time period of 335 ±5 μsec. Author

N65-20755*# IIT Research Inst., Chicago, Ill. Technology Center

BACKSTREAMING FROM OIL DIFFUSION PUMPS Summary Report, Dec. 1, 1963–Nov. 30, 1964

William M. Langdon 18 Dec. 1964 102 p refs
(Contract NASr-65(08))
(NASA-CR-57739; IITRI-C6030-4) CFSTI: HC $4.00/MF $0.75

Work on back streaming continued with emphasis on the mechanisms involved. The experimental variables were increased to include pumps—fractionating and nonfractionating; baffles—chevron-type, two bounce; one bounce, right angle elbow; oils–DC 705, Convalex 10, OS 124; operational procedures for fractionating effects; and mass spectrometer studies of mechanisms. All vacuum stations which operated with −75° F baffles gave high and varied back streaming values and also high system pressures. Duplication of previous values (using −75° F cooling) were obtained with DC 705 (chevron) and Convalex 10 (elbow) after operation with room temperature cooling. Author

N65-20796# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.
DEVELOPMENT OF MANUFACTURING METHODS FOR THE PRODUCTION OF INFILTRATED TUNGSTEN COMPOSITE ROCKET NOZZLE INSERTS Quarterly Progress Report, 1 Sep.–30 Nov. 1964
J. T. Smith and T. Vasilos 30 Dec. 1964 44 p refs
(Contract AF 33(615)-2090)
(QPR-1; AD-453352)

The technique for hot-pressing tungsten powders to controlled density, porous shapes is presented. These porous matrixes will be infiltrated for use as transpirational cooled rocket nozzle inserts. Eight types of powders are being evaluated to determine the most satisfactory ones for this application. Nondestructive testing, by ultrasonic measurements, showed that these billets are homogeneous in density within 1%. Mechanical strength of the tungsten matrixes increases linearly with increasing density. Pore size and distribution were determined. Arc plasma test facilities and an analytical model, to be used for evaluating the composites during transpirational cooling, are described. Author

N65-20839# Los Alamos Scientific Lab., N. Mex.
ROCK MELTING AS A DRILLING TECHNIQUE
Dale E. Armstrong, James S. Coleman, B. B. Mc Inteer, Robert M. Potter, and Eugene S. Robinson 15 Mar. 1965 38 p
(Contract W-7405-ENG-36)
(LA-3243) CFSTI: $2.00

Rocks melt rapidly in contact with tungsten or molybdenum heated electrically to incandescence. The metals exhibit excellent strength and resistance to corrosion. Drills applying these observations were constructed and tested with continuous removal of the lava. The hydrodynamics of molten rock moving beneath a drill is presented. Author

N65-20908# Westinghouse Electric Corp., Pittsburgh, Pa.
STUDY OF THE FEASIBILITY OF APPLYING ULTRASONIC ENERGY TO THE ROLLING PROCESS FOR SHEET METALS Progress Report, Aug.–Dec. 1964
James W. Cunningham and Ronald J. Lanyi [1964] 28 p
(Contract NOw-64-0294-j)
(PR-4; AD-613025)

A transducerized roll was successfully fabricated and installed in the rolling mill. Using a heat exchanger to prevent transducer heating, radial surface displacements of 0.06×10^{-3} to 0.08×10^{-3} inches at a frequency of 12 kc/sec could be continuously maintained during rolling. Load reductions of 5% to 16% were obtained while rolling lead at room temperature and aluminum at 500° C. No significant effect was observed on copper or steel or aluminum at room temperature. Author

N65-21027# Naval Ordnance Lab., White Oak, Md. Chemistry Research Dept.
NOL FILAMENT WINDING SYSTEM, DESIGN AND OPERATIONAL CHARACTERISTICS
Robert W. Eshbaugh Feb. 1965 34 p refs
(NOLTR-64-221; AD-611777)

The winding machine is a chain-driven lathe type. The major functions of the system, winding, tensioning and impregnation, together with instrumentation, are performed by 10 component groups, the most important of which are these: (1) The mandrel and carriage transmission system produces any helical pitch from 0 to 2.134 meters (0 to 84 in.) (12° to 90° on 6 in. diameter mandrel). (2) The electrical tensioning system has individual control and measurement from 0 to 4.54 kg (0 to 10 lbs) for each of four strands or from 0 to 9.08 kg (0 to 20 lbs) for each of two strands. (3) The servo-controlled feedeye extension system provides the basic two-motion machine with some of the winding capability of a three-motion machine. (4) The strand resin impregnation system provides a comparatively long wet out time. Author

N65-21047# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center
MACHINING OF TITANIUM ALLOYS
Carl T. Olofson, Arnold F. Gerds, Francis W. Boulger, and John A. Gurklis 2 Feb. 1965 28 p refs
(Contract AF 33(615)-1121)
(DMIC-Memo-199; AD-611846)

This memorandum summarizes current knowledge respecting the machining of titanium alloys, and deals with the following conventional machining operations: milling, face milling, peripheral milling, turning, boring, drilling, tapping, and grinding. The last section deals with chemical milling operations. Author

N65-21054# Ampex Corp., Redwood City, Calif.
DERIVATION OF GOVERNING EQUATIONS FOR SELF-ACTING FOIL BEARINGS
Edward J. Barlow Feb. 1965 29 p refs
(Contract Nonr-3815(00)(X))
(RR-65-1; AD-612720)

Contained is the derivation of the equations for the self-acting foil bearing. These equations include the effects of bending stiffness of the tape and of compressibility of the lubricant. They are nonlinear, and the boundary conditions are divided equally between the two ends of the tape. These complications even make obtaining numerical solutions difficult. Linearized solutions are derived for large wrap angles neglecting the bending stiffness of the tape. Author

N65-21062# Western Gear Corp., Lynwood, Calif.
HIGH ENERGY RATE FORGING DEVELOPMENT Final Report, Jan. 1961–Sep. 1964
M. L. Headman et al Wright-Patterson AFB, Ohio, AF Mater. Lab., Nov. 1964 162 p *Its* Rept.-6410-230
(Contract AF 33(600)-42523)
(AFML-TR-64-371; AD-612640)

A process was developed to produce no-draft, close tolerance forgings with difficult web sections and large material upset ratios by high energy rate forging (HERF) for a wide range of materials. Configurations were a no-draft two legged bracket, a web and rib scissor configuration, a rocket nozzle preform, and a thin webbed circular section. Materials successfully forged into complex shapes were AISI 4340, H-11 tool steel, Ti-6Al-4V, PH 15-7 Mo Stainless Steel, TZM Molybdenum alloy and unalloyed tungsten. Upset forgings of these materials established optimum forging parameters. Excellent grain flow patterns were achieved in all the configurations employed. The wrought refractory metals were found much superior to the arc-cast pressed and sintered material of the same composition. When tensile shear stresses were applied to the material under the optimum forging conditions, the wrought material was vastly superior. However, both materials performed well only under compressive loading. Author

N65-21063*# Hayes International Corp., Birmingham, Ala.
LOCKHEED MODIFIED AN FITTINGS FOR 3,000 PSIG HYDRAULIC SERVICE Engineering Test Report No. 10908

T. F. Gilmore Cocoa Beach, Fla., NASA. John F. Kennedy Space Center, 26 Aug. 1964 29 p
(Contract NAS8-2483)
(NASA-CR-57854) CFSTI: HC $2.00/MF $0.50

The 1 1/4-inch, 3/4- X 1/2-inch, and 1/2-inch fittings were subjected to a preliminary leakage test, temperature susceptibility leakage test, and a deflection leakage test. The results of these hydraulic leakage tests led to the following conclusions: (1) With a Teflon ring inserted between the tube flare and fitting, the tube would not turn on the fitting when torqueing the "B" nut. (2) The 1 1/4-inch, 3/4- X 1/2-inch, and 1/2-inch unions were leaktight when torqued to 1500 inch-pounds, 900 X 400 inch-pounds, and 400 inch-pounds respectively, and pressurized to 3000 psig. (3) At stabilized temperature extremes, sealing characteristics were not affected. (4) Deflection had no effect on the sealing characteristics of the test specimens. E.E.B.

N65-21094# Laboratorium für Betriebsfestigkeit, Darmstadt (West Germany).
FATIGUE LIFE OF A SINGLE-LIP, LIGHT METAL RIVETED-JOINT [ZEITFESTIGKEIT EINSCHNITTIGER LEICHTMETALL-NIETVERBINDUNGEN]
W. Schütz [1965] 103 p refs In GERMAN; ENGLISH summary (F-47)

Results of tests carried out to determine fatigue behavior of six different types of rivet joints in the range of 10^4 to 10^5 cycles at $R \approx +0.1$ allow the following conclusions to be drawn: (1) Fatigue life of rivet joints with machined countersinks is lower than that of snap head or cold dimpled countersink rivet joints. (2) Enlarging the shaft diameter from 3.2 to 4.0 mm increases fatigue life of snap head rivet joints. (3) Changes in fatigue life obtainable by variation of rivet type or rivet pattern are only of the same order of magnitude. (4) Sealants double fatigue life at the most. (5) Gain in fatigue life obtainable by use of a cabin differential pressure spectrum amounts to about 200% to 300%. (6) Deviations from nominal sheet thickness amounted from −1% to +12%. (7) Increasing testing frequency from 30 to 1800 cpm results in higher fatigue life. Author

N65-21123# Technisch Documentatie en Informatie Centrum voor de Krijgsmacht, The Hague (Netherlands).
A REVIEW OF LITERATURE ON WORKSHOP TECHNIQUES [LITERATUUROVERZICHT, WERKPLAATS-TECHNIEK]
23 Dec. 1964 12 p refs In DUTCH *Its* 9th Yearly Issue, No. 12, W-81

Selected briefs on work pertaining to materials research are presented for the areas of measurements, properties, vibrations, welding, lathing, cutting, lubrication, tooling, and machining. The productivity of repair shops, and the purchase of turning lathes were also briefly investigated. Trans. by G.G.

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N65-20135 Joint Publications Research Service, Washington, D. C.
STIMULATED EMISSION OF LIGHT FROM PURE Xe AND He-Xe
Chun-Ch'en Lin, Ch'en Hsing, Ching-jui Wang, Chung-i Wan, and Fei-hsuan Huang *In its* Transl. on Communist China's Sci. and Technol., No. 161 19 Mar. 1965 p 67–73 refs Transl. into ENGLISH from K'O Hsveh T'ung Pao (Peking), no. 1, Jan. 1965 p 71–72 (See N65-20134 10-34) CFSTI: $4.00

Stimulated light emissions from pure Xe and He-Xe gases in quartz discharge tubes showed a generally greater output through high-frequency discharge than through direct-current discharge. A high He-Xe mixture ratio induced cataphoresis and a severe Xe cleaning action. Wavelength measurements by infrared spectrometer were 2.027 microns for the pure Xe laser. Measurements of the He-Xe laser from coupled light stimulation of confocal or plane reflectors were 2.027μ; from coupled window lights of the discharge tube, 3.368μ; and from a window with a 20° angle, 3.508μ; with a relative power ratio of 64:9.4:100, respectively. G.G.

N65-20136 Joint Publications Research Service, Washington, D. C.
THE He-Ne LASER WITH SILVER COATINGS AND DIELECTRIC COATINGS
Chün-Ch'en Lin, Ch'en Hsing, Ching-jui Wang, Chung-I Wan, Fei-Hsüan Huang et al *In its* Transl. on Communist China's Sci. and Technol., No. 161 19 Mar. 1965 p 74–80 refs Transl. into ENGLISH from K'o Hsueh T'ung Pao (Peking), no. 1, Jan. 1965 p 73–74 (See N65-20134 10-34) CFSTI: $4.00

Laser emissions from a He–Ne mixture in a quartz discharge tube with silver coating produced output wavelengths of 1.1530 and 3.39 microns at high frequency excitation. The output power of the dc discharge was more than twice that of the high frequency discharge. The same gas mixture in a quartz tube with dielectric coating resulted in the 6328 Å light output, and in a hard glass discharge tube with 2 quartz glass planes the 1.1530 output was obtained. It was concluded that the technical requirements for development of relatively high efficiency gas lasers are not too stringent. G.G.

N65-20166# Services Electronics Research Lab., Baldock (England).
S.E.R.L. TECHNICAL JOURNAL, VOL. 15, NO. 1, FEBRUARY 1965
[1965] 81 p refs

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3. YIELD FROM BAKABLE ERBIUM TARGETS FOR NEUTRON GENERATORS L. N. Large and H. Hill 7 p refs (See N65-20169 10-24)

4. A PULSED GAS LASER FOR THE FAR INFRA-RED L. N. Large and H. Hill 7 p refs (See N65-20170 10-16)

5. STIMULATED EMISSION IN THE FAR INFRA-RED FROM WATER VAPOUR AND DEUTERIUM OXIDE DISCHARGES L. E. S. Mathias and A. Crocker 5 p refs (See N65-20171 10-16)

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7. LASER OSCILLATIONS AT WAVELENGTHS BETWEEN 21 AND 32 μ FROM A PULSED DISCHARGE THROUGH AMMONIA L. E. S. Mathias, A. Crocker, and M. S. Wills 3 p refs (See N65-20173 10-16)

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11. DESIGN OF A COMPACT 100-WATT GaAs LASER TRANSMITTER K. G. Hambleton and F. E. Birbeck 9 p refs (See N65-20177 10-16)

N65-20170 Services Electronics Research Lab., Baldock (England).

A PULSED GAS LASER FOR THE FAR INFRA-RED

L. N. Large and H. Hill *In its* S.E.R.L. Tech. J., Vol. 15, No. 1, Feb. 1965 [1965] 7 p refs Submitted for Publication (See N65-20166 10-16)

A compact sealed-off pulsed laser was developed for the far infrared region of the spectrum. This source which is 1 meter in length emits radiation at 27.9μ using a pulsed water vapor discharge. Peak output powers around 10 watts are obtained in light pulses of 1-microsecond duration. By using a water vapor replenisher and by constructing the laser so that it is capable of thorough vacuum baking before filling, a long life is insured. This source has immediate applications in the field of plasma diagnostics. Author

N65-20171 Services Electronics Research Lab., Baldock (England).

STIMULATED EMISSION IN THE FAR INFRA-RED FROM WATER VAPOUR AND DEUTERIUM OXIDE DISCHARGES

L. E. S. Mathias and A. Crocker *In its* S.E.R.L. Tech. J., Vol. 15, No. 1, Feb. 1965 [1965] 5 p refs Submitted for Publication (See N65-20166 10-16)

A high Q optical resonator was used to produce oscillations to obtain as complete a stimulated emission spectrum as possible for water vapor and deuterium oxide, in order to interpret more completely the molecular processes involved. Apparatus, calibration procedures, techniques, and results are reported. With water vapor flowing through the apparatus, oscillations were obtained at 32 wavelengths in the range 16 to 121 microns. In general, the oscillations were optimum at a gas pressure of 1 torr and at charging voltages between 16 and 21 kV. With deuterium oxide, at a pressure of 1 torr, oscillations were obtained at 16 wavelengths in the range of 33 to 108 microns. The wavelengths and wave numbers are included. E.E.B.

N65-20172 Services Electronics Research Lab., Baldock (England).

LASER OSCILLATIONS FROM NITROUS OXIDE AT WAVELENGTHS AROUND 10.9μ

L. E. S. Mathias, A. Crocker, and M. S. Wills *In its* S.E.R.L. Tech. J., Vol. 15, No. 1, Feb. 1965 [1965] 4 p refs Submitted for Publication (See N65-20166 10-16)

Laser oscillations at a number of closely spaced wavelengths around 10.9μ were obtained from a pulsed electrical discharge through nitrous oxide. The transitions are P branch transitions in a vibration–rotation band, either the 001 to 100 or the 002 to 101 band, in the ground electronic state of the molecule. Author

N65-20173 Services Electronics Research Lab., Baldock (England).

LASER OSCILLATIONS AT WAVELENGTHS BETWEEN 21 AND 32 μ FROM A PULSED DISCHARGE THROUGH AMMONIA

L. E. S. Mathias, A. Crocker, and M. S. Wills *In its* S.E.R.L. Tech. J., Vol. 15, No. 1, Feb. 1965 [1965] 3 p refs Submitted for Publication (See N65-20166 10-16)

Laser oscillations were obtained at a pressure of 2.4 torr and charging voltage of 27 kV with ammonia flowing through the discharge tube. The pulse repetition frequency was 1 cps, gas flow was above 25 liters/min, peak amplitude was approximately 400A, with a rise time of 1.6 microsecond, and an overall duration of 3.6 microseconds. Oscillations were obtained at 7 wavelengths between 21 and 32 microns. With a constant average gas pressure, the total output power from the laser increased with charging voltage and reached a saturation value at 2.4-torr pressure and 27 kV. Data are tabulated and results discussed. E.E.B.

N65-20174 Services Electronics Research Lab., Baldock (England).

OPTICAL GAIN IN NEON AND HELIUM/NEON PULSED DISCHARGES

D. M. Clunie and N. H. Rock *In its* S.E.R.L. Tech. J., Vol. 15, No. 1, Feb. 1965 [1965] 4 p refs Submitted for Publication (See N65-20166 10-16)

Optical amplification in the near-infrared produced by a pulsed electrical discharge in pure neon and in a helium–neon mixture is reported. Amplification was observed at 1.153 microns in a pure neon discharge over a pressure range of 0.018 to 3.5 torr with a maximum at 0.3 torr. The duration of the gain was only 0.1 microsecond with a rise time of 0.02 microseconds or less. With a path length of 18 meters an optical gain of 6.9×10^4 was measured. The mixture of helium and neon showed amplification over a wide range of pressures. The optimum neon pressure is 5 torr. The gain increases with increasing helium pressure until a pressure is reached where the discharge becomes nonuniform. Pressures of 5-torr neon and 155-torr helium gave a gain lasting for about 1 microsecond. Results obtained at 1.153 microns for a discharge path of 12 meters are presented. It was estimated that the power per liter obtained was between 62 to 90 watts/liter. E.E.B.

N65-20175 Services Electronics Research Lab., Baldock (England).

A COMPACT PULSE GENERATOR FOR DRIVING GALLIUM ARSENIDE LASERS AT ROOM TEMPERATURE

R. F. Broom *In its* S.E.R.L. Tech. J., Vol. 15, No. 1, Feb. 1965 [1965] 7 p refs Submitted for Publication (See N65-20166 10-16)

A simple apparatus employing a mechanical contact in conjunction with a low inductance circuit was found capable of generating current pulses of up to 2400 A with a rise time in the region of 20 nsecs and at a pulse repetition frequency of between 10 and 100 cps. Used to drive a GaAs laser at room temperature of junction area $1.6 \times 10^{-3} cm^2$ at a current of 800 A, a peak light output power of 5 watts was obtained. Together with its associated transistor circuits the device measures only 2 1/8 in. in diameter by 6 in. in length. Current consumption is low enough for it to be powered from a dry battery. Author

N65-20176 Services Electronics Research Lab., Baldock (England).

A SEMICONDUCTOR LASER ARRAY

R. F. Broom *In its* S.E.R.L. Tech. J., Vol. 15, No. 1, Feb. 1965 [1965] 4 p Presented at I.E.E. Conf. on Lasers and their Applications, London, 29 Sep. 1964 (See N65-20166 10-16)

A method of producing a parallel beam from a laser array and the construction of an optical system of 10 lasers is described. Each laser diode is 2 mm long and 1 mm wide across the emitting surface. Preliminary measurements on single units indicated that the array will give a peak light output of 1 kW and a mean output approaching 10W. The measured bandwidth was 5 milliradians in a horizontal plane and 2 milliradians in a vertical plane. When driven with 240 A, 0.7 μsec pulses, the peak light power output was 500W. E.E.B.

N65-20177 Services Electronics Research Lab., Baldock (England).

DESIGN OF A COMPACT 100-WATT GaAs LASER TRANSMITTER

K. G. Hambleton and F. E. Birbeck *In its* S.E.R.L. Tech. J., Vol. 15, No. 1, Feb. 1965 [1965] 9 p refs Presented at I.E.E. Conf. on Lasers and their Applications, London, Sep. 1964 (See N65-20166 10-16)

The design of a compact GaAs laser transmitter with performance sufficient to illustrate the potential of lasers is described. The properties considered desirable for general applications are enumerated. A limit of peak power of 100 watts was chosen for a single GaAs laser, which was set by the mean Joule heating in the laser series resistance. The laser, cooling system, and pulse generator designs are detailed. The final pulse generator circuit using the silicon controlled rectifier gave 200 A pulses 0.5 microseconds long and at repetition frequencies of over 10 kc/sec. E.E.B.

N65-20300# Northrop Space Labs., Hawthorne, Calif.

INVESTIGATION OF THE SCATTERING OF A LASER BEAM BY THE ELECTRONS OF A PLASMA Final Technical Report

D. W. Mc Morris and H. N. Olsen Dec. 1964 45 p refs
(Contract AF 49(638)-1336)
(NSL-64-168-1; AFOSR-65-0033; AD-610167)

The radiation scattered from the beam of a laser by free electrons of a test plasma has been investigated as a possible tool for plasma diagnostics at electron densities in the range of 10^{16} to 10^{17} cm^{-3} and temperatures from 10000° to 20000° K. A perturbing effect on the plasma background radiation was observed which masked the expected Thomson scattering. This perturbation is interpreted as a plasma heating resulting from energy transferred to the plasma from the laser beam by coupling of the electromagnetic field with the plasma charged particles. Author

N65-20391 Library of Congress, Washington, D. C. Aerospace Technology Div.

ELECTRON-BEAM-PUMPED LASER

In its Foreign Sci. Bull., Vol. 1, No. 1, Jan. 1965 [1965] p 1–3 refs (See N65-20390 10-34)

Soviet research on the electron-beam-pumped semiconductor laser is reviewed, from the early unsuccessful attempts to the development of an operating device. Author

N65-20562# Perkin-Elmer Corp., Norwalk, Conn. Electro-Optical Div.

INVESTIGATION OF TECHNIQUES FOR MODULATING AND SCANNING A LASER BEAM TO FORM A VISUAL DISPLAY Final Report, Jun. 1963–Jun. 1964

Paul R. Yoder, Jr. et al Griffiss AFB, N.Y., RADC, Jan. 1965 352 p refs *Its* Report.-7600
(Contract AF 30(602)-3122)
(RADC-TDR-64-365; AD-612725)

Various techniques which might be used to modulate and deflect a laser beam in response to an input video signal to form a projected visual display containing 10^6 resolved information bits at 30 frames per second are considered. The Pockel cell using potassium dihydrogen phosphate is considered. The design and experimental evaluation of a breadboard three-pass KDP modulator conducted under this investigation are summarized. This type of device should be capable of providing the required performance. Slow scanning of the beam at 30 cycles per second is found feasible using a piezoelectrically driven nodding mirror scanner. Two specially designed and slightly different scanners of this basic type are described. Under sawtooth waveform excitation of 150 volts peak to peak, beam deflections of ±15 milliradians linear to ±2% for 90% of each cycle were obtained without excessive distortion of the mirror surface. Author

N65-20605# Naval Ordnance Lab., White Oak, Md.

TRANSMISSION OF GREEN LASER LIGHT (5300A) THROUGH WATER

D. E. Matlack, H. A. Templin, and W. W. Talbert Jan. 1965 27 p refs
(NOLTR-64-179; AD-610071)

The extinction coefficient of filtered Potomac River water was measured at the frequency doubled neodymium green laser wavelength of 5300Å. Measurements were conducted in situ at the David Taylor Model Basin (DTMB). Extinction coefficients of 0.097, 0.104, and 0.119 m^{-1} were measured on June 4, 5 and 8, 1964, respectively. The increase in attenuation with time is confirmed by filtered arc light measurements, and is attributed to contamination of the water after the basin filtration system was turned off. Scattering experiments indicate that the aureole effect for the highly collimated laser beam was small over the 200-meter range of the measurements. Author

N65-20782 Joint Publications Research Service, Washington, D. C.

SEPARATION OF WAVE MODES OF GASEOUS LASER

Hsi-ming Kuo, Shu-sheng Yu, Chou Hang, and Hsueh-ming Yen *In its* Transl. on Communist China's Sci. and Technol., No. 163 24 Mar. 1965 p 116–121 refs Transl. into ENGLISH from K'o-hsueh T'ung-pao (Peking), no. 1, Jan. 1965 p 69–70 (See N65-20778 10-34) CFSTI: $4.00

A method of separating the single wave modes, and observations of the output pattern of single wave oscillation modes are presented. An external type He–Ne mixture gaseous laser was used. The quartz discharge tube with a Brewster window was 220 cm long, 8 mm in radius, with pressure of 1.1 mm Hg. The helium-to-neon pressure ratio was approximately 10:1. The resonant cavity was composed of two spherical reflectors of high reflectivity, with a radius of curvature of 220 cm and a spacing between them of 245 cm. It was excited by high frequency external electrodes with an output wavelength of 6328 Å. The discharge length was shortened to separate the longitudinal modes, until the beat signal of two neighboring modes completely disappeared. This assured that there was only one longitudinal mode taking part in the oscillation. E.E.B.

N65-20915# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

QUANTUM MICROWAVE AMPLIFIERS AND OSCILLATORS (MASERS)

M. Odehnal and V. Petricek 9 Mar. 1965 46 p refs Transl. into ENGLISH from Cesk., Casopis Fys. (Prague), no. 6, 1963 p 500–528
(FTD-TT-64-1006/1+2; AD-460180)

The principles and electronic properties of quantum amplifiers and oscillators in radiofrequency and microwave bands are discussed. It was concluded that quantum electronics is a young branch of modern electronics, combining the techniques of all wave bands of electromagnetic emission up to the ultraviolet zone with spectroscopy of solid, liquid, and gaseous phases. Quantum physics enables the realization of amplifiers and oscillators with excellent properties. It has also expanded the possibilities of practical electronics. E.E.B.

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N65-20178# Watervliet Arsenal, N. Y.
APPLICATION OF MARAGING STEELS
[1964] 113 p ref Report of the Conf. held at Watervliet Arsenal, N.Y., 6 Feb. 1964
(AD-609261)

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5. EXTRUDED 90mm RECOILLESS RIFLE GUN TUBES V. Colangelo p 31–38 (See N65-20182 10-17)
6. MACHINING OF PROTOTYPE GUN COMPONENTS UTILIZING MARAGING STEELS T. Kucskar p 38–46 (See N65-20183 10-17)
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10. MACHINING CHARACTERISTICS OF 18% NICKEL MARAGING STEEL E. Fowler (Intern. Nickel Co.) p 81–90 (See N65-20187 10-17)
11. SUMMARY OF PRESENT STATUS OF MARAGING STEEL N. Matthews (Intern. Nickel Co.) p 91–92 (See N65-20188 10-17)
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N65-20179 Watervliet Arsenal, N. Y.
HISTORY AND PERFORMANCE OF MARAGING STEELS AT WATERVLIET ARSENAL
J. Penrose *In its* Appl. of Maraging Steels [1964] p 2–5 (See N65-20178 10-17)

Recent work on the use of the maraging steels is briefly reviewed. Maraging steel was used for the 81-mm mortar tube, the 107-mm mortar tube, and the breech ring for a howitzer. In the case of the mortar tubes, the maraging steel was successful in withstanding the pressure generated. However, the results were disappointing in the breech ring application. Yield strength was found to be about 260 000 psi, reduction in area was about 4%, and the −40° F impact test was about 4 ft-lb. The breech ring failed in a short time during simulation firing. The poor performance of the maraging steel in the breech ring application was attributed to the very poor ductility and toughness of the steel. E.E.B.

N65-20180 Watervliet Arsenal, N. Y.
LOW CYCLE FATIGUE DATA
J. Barranco *In its* Appl. of Maraging Steels [1964] p 6–14 ref (See N65-20178 10-17)

The notch sensitivity in low-cycle fatigue of a series of high-strength materials was investigated. It was found that the notch sensitivity of 4330 (modified) steel in the low-cycle fatigue region is low and essentially constant to tensile-strength levels of 173 000 psi. Between 173 000 psi and 192 000 psi tensile strength, there is a marked increase in notch sensitivity to about twice that for lower strength levels. Underaging of type 300 maraged steel at lower strength levels enhances ductility but does not substantially improve the notch sensitivity. Two groups of type 250 maraged steel having vastly different reduction-in-area properties showed nearly identical values of notch sensitivity. E.E.B.

N65-20181 Watervliet Arsenal, N. Y.
INVESTIGATION OF XM103 GUN TUBES
F. Heiser *In its* Appl. of Maraging Steels [1964] p 15–30 (See N65-20178 10-17)

Three gun tubes of maraged steel were solution annealed and then aged for 3 hours at 900° F. Approximately 400 rounds were fired from one of the tubes before firing was discontinued. The tube had been borescope inspected after every 50 rounds. The defect which caused the stoppage appeared only at the 400-round inspection. The bore of the tube was washed with a sulfuric acid solution to remove copper deposited from the rotating band, after 300 rounds and again after 350 rounds. The heat checking pattern observed is not peculiar to the maraging steel. Similar checking is observed in gun steel tubes. However, the deep cracks which were observed are not common. The cause of the cracking was not ascertained

with certainty. The cracks may have been due to stress corrosion or to the presence of grain boundary precipitate—such a grain boundary precipitate was found but could not be related to the cracking. E.E.B.

N65-20182 Watervliet Arsenal, N. Y.
EXTRUDED 90mm RECOILLESS RIFLE GUN TUBES
V. Colangelo *In its* Appl. of Maraging Steels [1964] p 31–38 (See N65-20178 10-17)

Lightweight gun barrels are ordinarily formed by machining from forged billets. Extrusion was initially considered for reasons of economy to reduce machining costs and lead times. An extruded barrel should not require any major machining except where external contouring is necessary. Three methods for the barrel extrusion were considered. The method selected was to hot extrude the tube, to cold size the tube and then, by means of a rifling die or rifling button, to extrude the rifling by either forcing the tube through the die or drawing the button through the center of the tube. Illustrations of the hot extruded and cold rifled 57-mm gun tube are included. Also, the methods for testing thin wall tubes are discussed. E.E.B.

N65-20183 Watervliet Arsenal, N. Y.
MACHINING OF PROTOTYPE GUN COMPONENTS UTILIZING MARAGING STEELS
T. Kucskar *In its* Appl. of Maraging Steels [1964] p 38–46 (See N65-20178 10-17)

Maraging steel was provided skilled machinists for the production of gun components. They were given a drawing and had a schedule to meet. Later, each was interviewed with reference to the machinability of the steel. It was the general consensus that maraging steel can be machined quite satisfactorily with the following precautions: (1) Use a high hardness (Rc70) high speed steel cutting tool of the cobalt type. (2) Use an extreme pressure additive lubricant, with a highly sulfurized, chlorinated mineral oil content to prevent welding the cutting tool to the chip. (3) Do not use high speeds or force the feed. E.E.B.

N65-20184 Watervliet Arsenal, N. Y.
STRAIN RATE EFFECT IN MARAGING STEELS
D. Kendall *In its* Appl. of Maraging Steels [1964] p 46–47 (See N65-20178 10-17)

Results of experimental work on the strain rate effects on high strength alloy steels, including 300-type maraging steel, are reported. A high speed tensile testing machine which will develop 60000-lbs force in approximately 1 millisecond was used. This machine will produce a strain rate on the maraging steel of about 10 inches/inch-sec. These high strain rates are of interest since the strain rates in a typical gun chamber are in the order of 1 inch/inch-sec. Generally, the consensus is that high strength steels are not strain sensitive. However, they are not completely insensitive to strain rate. For the maraging steel, when 0.2% yield strength was plotted as a function of strain rate on a log-log scale, a linear relationship was obtained. At a strain rate of 10^{-4} in/in-sec, the yield strength was 270 ksi. At 10 in/in-sec, this increased 10% to 295 ksi. E.E.B.

N65-20185 International Nickel Co., Inc., New York.
EFFECT OF COMPOSITION AND PROCESSING VARIABLES ON MARAGING STEEL
B. Schaaf *In* Watervliet Arsenal Appl. of Maraging Steels [1964] p 47–62 (See N65-20178 10-17)

The effects of the composition variables on the mechanical properties of the maraging steels are reviewed. Nickel provides the tough ductile martensitic matrix. As a strengthener it contributes about 500 psi per 0.1%. Cobalt and molybdenum are the principal strengthening elements in maraging steel. Strengthening effects are 900 psi and 2000 psi per 0.1% respectively. Titanium is a very potent strengthener with a contribution of the order of 10000 psi per 0.1%. Aluminum is added as a deoxidizer. Boron and zirconium have little effect on the mechanical properties but are added to enhance resistance to stress corrosion. Also several factors are given which should be considered in the stages of hot reduction of maraging steel: (1) restrict temperature to 2000° F; (2) finish hot-working at as low a temperature as possible; (3) cool rapidly; (4) restrict annealing temperatures to the minimum; and (5) avoid prolonged annealing. E.E.B.

N65-20186 International Nickel Co., Inc., New York.
MECHANICAL PROPERTIES OF MARAGING STEELS
T. Landig *In* Watervliet Arsenal Appl. of Maraging Steels [1964] p 62–[illegible] (See N65-20178 10-17)

Stress–strain characteristics of the 200, 250, and the 300 maraging steels were diagrammed to show that the slope of such curves in the plastic deformation region corresponds to a strain hardening exponent of about 0.03. This is a relatively low strain hardening exponent indicating a low rate of strain hardening in the material. In the design of a tough steel, the carbon content must be decreased. The lower the carbon content, in general, the greater the toughness of the steel. This principle is inherent in the design of the maraging steels. Also; tensile strength when plotted against notched tensile strength shows that the maraging steels exhibit very good fracture toughness. E.E.B.

N65-20187 International Nickel Co., Inc., New York.
MACHINING CHARACTERISTICS OF 18% NICKEL MARAGING STEEL
E. Fowler *In* Watervliet Arsenal Appl. of Maraging Steels [1964] p 81–90 (See N65-20178 10-17)

Experience gained on machining 250000 tensile strength materials and the maraging steels resulted in the conclusion that annealed and hot rolled maraged steels, although of higher hardness, still have very excellent machinability in comparison with other materials. A compilation of data on various machining operations is included. Also, graphs illustrating the machining characteristics of maraging steels are presented. E.E.B.

N65-20188 International Nickel Co., Inc., New York.
SUMMARY OF PRESENT STATUS OF MARAGING STEEL
N. Matthews *In* Watervliet Arsenal Appl. of Maraging Steels [1964] p 91–92 (See N65-20178 10-17)

The tendency towards segregation and other phenomena that detract from transverse ductility in forging billets is discussed. Also, a program to optimize processing methods to achieve maximum transverse ductility and toughness is summarized. Embrittlement, fatigue, and notch toughness are considered. It appears that there is not much that can be done about increasing work hardening without damaging notch toughness or some other desirable characteristic. E.E.B.

N65-20189 International Nickel Co., Inc., New York.
AVAILABILITY OF [illegible]RATEGIC MATERIALS IN MARAGING STEELS
D. Cassidy *In* Watervliet Arsenal Appl. of Maraging Steels [1964] p 92–93 (See N65-20178 10-17)

The availability of nickel, cobalt, and molybdenum is discussed. The present free world consumption amounts to approximately 525 million lbs of nickel annually. Half of this is in the United States. The present free world production capacity is 640 million lbs. The best estimate in the critical and strategic stockpile is 450 million lbs. The situation with cobalt is similar. The free world consumption is approximately 33 million lbs. Of this, the U.S. consumption runs about 9 million lbs. The production in Katanga, largest single production area, is about 18 1/2 million lbs. The present U.S. production is 2.6 million lbs. and Canadian production is 3.4 million lbs. About 5 years supply of cobalt is in the U.S. stockpile. The free world consumption of molybdenum is about 77 million lbs. The U.S. produces 85% of the world supply. Approximately 1 year's supply is in stockpile. E.E.B.

N65-20251# Defence Research Board, Ottawa (Ontario). Directorate of Scientific Information Services

EMBRITTLEMENT OF STEEL BY EXTERNAL EFFECT OF MOLECULAR HYDROGEN

Wilhelm Hofmann and Walter Rauls Apr. 1964 5 p refs Transl. into ENGLISH from Abhand. Braunschweig. Wiss. Ges. (Brunswick), v. 13, 1961 p 158–162

The behavior of steel-containing hydrogen is briefly described, and a report given about tensile tests conducted in a hydrogen atmosphere of high pressure (up to 150 atm). If hydrogen is present during plastic deformation of the steel, a deterioration of the surface in the form of cracks and a considerable loss of ductility will occur. Increasing hydrogen pressure and decreasing strain rate intensify the embrittling effect of the gas. Author

N65-20290# Joint Publications Research Service, Washington, D. C.

STUDIES IN TITANIUM ALLOYS

26 Mar. 1965 30 p refs Transl. into ENGLISH of 5 Articles from Russian Publ.

(JPRS-29305; TT-65-30594) CFSTI: $2.00

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N65-20291 Joint Publications Research Service, Washington, D. C.

STRUCTURE FEATURES AND DIFFUSION MOBILITY IN TITANIUM ALLOYS IN DIFFERENT PHASE STATES

S. Z. Bokshteyn, T. A. Yemel'yanova, S. T. Kishkin, and L. M. Mirskiy *In its* Studies in Titanium Alloys 26 Mar. 1965 p 1–11 refs Transl. into ENGLISH from the Publ. "Protsessy Diffuzii, Struktura i Svoystva Metallov" Moscow, Mashinostroyeniye, 1964 p 117–132 (See N65-20290 10-17) CFSTI: $2.00

The structural features of the beta–alpha transformation were studied, and the diffusion permeability of titanium-base alloys in different phase states was evaluated. By considering data on the preferential diffusion of carbon in the grain boundaries of alpha- and gamma-iron, it was possible to assume, in the process of diffusion, that carbon atoms migrate primarily via defects of the crystal structure. Therefore, the structure of titanium alloys was investigated by studying the distribution of carbon and, in some cases, nickel during diffusion in beta- and alpha-phases. The following was established: (1) the mobility of molybdenum during diffusion in the beta-phase of alloy VT15 was less than diffusion in the heterophase region of this alloy; and (2) the diffusion permeability of the equiaxial alpha-phase in alloy VT3-1 is less than that in acicular alpha-phase. Recrystallization of the alpha-phase in alloy VT3-1 leads to increased diffusion mobility of the atoms. E.E.B.

N65-20292 Joint Publications Research Service, Washington, D. C.

THERMOMECHANICAL TREATMENT OF BETA-TITANIUM ALLOYS

S. Z. Bokshteyn, G. S. Glazunov, T. A. Yemel'yanova, Yu. N. Kabanov, S. T. Kishkin et al *In its* Studies in Titanium Alloys 26 Mar. 1965 p 12–17 Transl. into ENGLISH from the Publ. "Protsessy Diffuzii, Struktura i Svoystva Metallov" Moscow, Mashinostroyeniye, 1964 p 177–182 (See N65-20290 10-17) CFSTI: $2.00

The thermomechanical treatment of VT15 (3.76Al–7.8Mo–10.7Cr) and V-120 (3.1Al–11.6Cr–12.6V) is reported. An increase in strength properties after thermomechanical treatment with a simultaneous drop of ductility at room temperature, and a considerable increase in ductility at 400° C was observed. The tensile strength and yield point after thermomechanical treatment rose by 18 to 20 kg/mm^2 in comparison with the strength of the conventionally heat-treated alloy. The ductility at room temperature was somewhat lower, but was restored at 400° C. A comparison of the results of short-time tests of alloy VT15 for the same degree of plastic deformation at different deformation temperatures showed that the strength of this alloy after thermomechanical treatment at 350° C was somewhat better than 760° C. At the same time the relative elongation in both cases remained the same but reduction in area at 350° C was somewhat better than at 760° C. E.E.B.

N65-20293 Joint Publications Research Service, Washington, D. C.

EFFECT OF PLASTIC DEFORMATION ON THE STRUCTURE AND PROPERTIES OF VT14, VT15, AND VT16 WELD JOINTS

S. G. Glazunov, A. I. Korev, V. N. Moiseyvev, and L. V. Geras'kova *In its* Studies in Titanium Alloys 26 Mar. 1965 p 18–22 Transl. into ENGLISH from Svarochnoye Proizvodstvo (Moscow), no. 10, Oct. 1964 p 27–28 (See N65-20290 10-17) CFSTI: $2.00

The results of research on determining the effect of cold deformation up to 60% and heat treatment on the properties of weld joints are presented. It has been shown that the properties of joints are improved as a result of deformation. Author

N65-20294 Joint Publications Research Service, Washington, D. C.

INFLUENCE OF HIGH-TEMPERATURE THERMOMECHANICAL TREATMENT ON THE BIAXIAL TENSILE STRENGTH OF ALLOY VT15

S. G. Glazunov and A. I. Khorev *In its* Studies in Titanium Alloys 26 Mar. 1965 p 23–25 Transl. into ENGLISH from Metalloved. i Term. Obrabotka Metal. (Moscow), no. 8, Aug. 1964 p 37–38 (See N65-20290 10-17) CFSTI: $2.00

Alloy VT15, a titanium alloy with approximately 11% Cr, 7% Mo, and 3% Al, has a beta-structure upon water quenching and air cooling from temperatures above 700° C. This nonequilibrium phase is stable and does not decompose during deformation. However, upon aging it will decompose and precipitate dispersed alpha-phase particles. This decomposition is accompanied by a significant increase in strength. Investigation of this alloy in biaxial tension was conducted on cylindrical tubular-tank samples with a diameter of 100 mm made from extruded tubes. Data were presented to show that the high-temperature thermomechanical treatment improved the structure and increased the strength of the alloy tanks in biaxial loading. E.E.B.

N65-20295 Joint Publications Research Service, Washington, D. C.

EXPERIENCE IN ROLLING THIN STRIP FROM HEAT-TREATED TITANIUM ALLOYS

E. R. Shor and A. M. Chinenov *In its* Studies in Titanium Alloys 26 Mar. 1965 p 26–28 Transl. into ENGLISH from Byull. Tekh.-Ekon. Informatsii (Moscow), no. 11, Nov. 1964 p 8–9 (See N65-20290 10-17) CFSTI: $2.00

Titanium and titanium alloys have three primary advantages over other structural metals: low specific gravity, high mechanical properties, and excellent resistance to corrosion. Because of these properties it is being used as a lining for steel tanks and pipelines in the chemical industry. The multistage deformation in the rolling process in discussed. Rolling is done with the use of special lubricants. The total pressure of the metal on the rollers during cold rolling of strip is 200 tons for VT14 at a reduction of the strip after vacuum annealing of approximately 30%. This value is 220 tons for VT15 and 230 tons for VT16. The specific pressure in the rolling of thin, unclad strip from high-strength titanium alloys varies between 175 and 225 kg/mm^2. In multistage deformation in the rolling process, the limiting magnitude of total reduction between annealings is 30% to 35%, whereas the number of passes between annealings may reach 30 with a single reduction per pass of about 0.01 mm to 0.02 mm. E.E.B.

N65-20303# Missouri School of Mines and Metallurgy, Rolla. Dept. of Metallurgical Engineering

THE VALENCY OF ALUMINUM IONS AND THE ANODIC DISINTEGRATION OF THE METAL

M. E. Straumanis and K. Poush Jan. 1965 21 p refs
(Contract Nonr-2296(03))
(TR-11; AD-610194)

Experiments made in aqueous solutions of NaOH, HNO_3, KNO_3 and $K_2Cr_2O_7$ showed that at anodic current densities between 20 and 300 mA/cm^2 dark, nearly black films are formed on the Al electrode. Microscopic examinations revealed the presence of a multitude of metallic particles entangled in the hydrated Al-oxide flakes, causing the dark color of the latter. Depending upon the conditions, the diameter of the metallic particles varied from almost 10^{-5} to 10^{-2} mm. Such a disintegration of Al was also observed when the partially amalgamated metal came simply in contact with distilled H_2O: dark flakes of hydroxide, containing a multitude of smallest Al particles, were formed. There are indications that the disintegration of Al is caused by the forcible breakdown (e.g. by the current or Hg) of the oxide layers firmly sticking to the surface of the metal. Author

N65-20413# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering

AN INVESTIGATION OF DIFFUSION IN THE COLUMBIUM VANADIUM SYSTEM

Robert Charles Geiss (M.S. Thesis) Aug. 1962 100 p refs
(GA/MECH-62-2; AD-610234)

Diffusion rates in the Cb–V system were investigated using electron microprobe analysis of the diffusion zones to determine concentration gradients. The interdiffusion coefficient D was found using a computer program to solve the Matano–Boltzman method. Activation energies Q and frequency factors D_0 were derived from values of D at the same concentrations but at different temperatures. Diffusion in the Cb–V system is apparently by vacancy mechanism. Author

N65-20455# IIT Research Inst., Chicago, Ill. Technology Center

EMBRITTLEMENT OF METALS BY ORGANIC LIQUIDS Quarterly Report, Sep. 1–Nov. 30, 1964

W. Rostoker 6 Jan. 1965 9 p
(Contract DA-11-ORD-022-3108)
(IITRI-B183B2-7; AD-610358)

It is shown that the Rebinder effect involving the embrittlement of steel by organic liquids is in reality due to water absorption by the organic species. The organic liquids which normally cause early fatigue do not produce this effect in the presence of a strong dehydration agent. Author

N65-20457# India. Dept. of Atomic Energy, Bombay. Metallurgy Div.

METASTABLE PHASES IN URANIUM ALLOYS WITH HIGH SOLUTE SOLUBILITY IN THE B.C.C. GAMMA PHASE PART I: THE SYSTEM U-Nb

K. Tangri and D. K. Chaudhuri 1964 43 p refs
(AEET-MET-2)

Composition limits of metastable phases α, α', and γ^0 and changes in parameters a, b, c and angle γ (ab) of the alpha uranium lattice with increasing niobium additions, have been determined. While parameter a is not affected sensibly, the parameters b and c steadily decrease and increase respectively. The angle γ shows an abrupt change from 90° at 10.00 at% Nb to 91.07° at 11.93 at% Nb. From a study of the effect of cooling rates in producing alternative structures, it is shown that the mode of formation of α', α'', and γ^0 in the U-Nb system is similar to that observed in the U-Mo system. Based on the size of the solute atom, a relationship is developed to predict the α/α'' boundary composition in various uranium binary systems with high solute solubility in the gamma phase. Author

N65-20459# Naval Weapons Lab., Dahlgren, Va. Warhead and Terminal Ballistics Lab.

THE EFFECTS OF EXPLOSIVELY INDUCED STRESS WAVES ON THE MECHANICAL PROPERTIES OF SEVEN METALS

Lester A. Potteiger 20 Nov. 1964 52 p refs
(NWL-1954; AD-454763)

An oblique stress wave of approximately 160 to 205 kilobars was induced in metal specimens of cupro nickel, inconel, monel, A nickel, stainless steel, and low carbon steel by detonation of TNT, H-6, and Composition B explosives in direct contact. The effects of this stress application were to increase tensile strengths by 18% to 107%, to increase hardnesses 49% to almost 200%, and to reduce impact strengths approximately 30% to 80%, depending on the type of metal and explosive. Composition B explosive was found to produce a greater change in the mechanical properties than either TNT or H-6. Author

N65-20466*# India. Dept. of Atomic Energy, Bombay. Metallurgy Div.
METASTABLE PHASES IN URANIUM ALLOYS WITH HIGH SOLUTE SOLUBILITY IN THE B.C.C. GAMMA PHASE. PART II: THE SYSTEM U-Ru
K. Tangri, D. K. Chaudhuri, and C. N. Rao 1964 24 p refs (AEET/MET/3)

In U–Ru alloys containing up to 9.51 at% Ru, the metastable phases α' and γ^0 produced on water quenching from the gamma field were studied by X-ray diffraction and metallography. For composition up to 6.90 at% Ru only α' phase is produced, whereas for higher compositions both the phases α' and γ^0 coexist. The absence of the phase α'' may be ascribed to the incompressibility of the b parameter below 5.80 Å, which may be due to the possible variation in the state of ionization of the ruthenium atoms when present in varying amounts in the uranium matrix. A possible explanation for the coexistence of the phases α' and γ^0 is that the γ^0 phase which requires more than 10 at% ruthenium for its formation will be present as small incoherently diffracting nuclei in the gamma phase and that these nuclei will grow into larger domains depleting partly the ruthenium content of the surrounding regions thus rendering them more susceptible to shear producing the phase α'. Author

N65-20467# Air Force Systems Command, Wright-Patterson AFB Ohio. Foreign Technology Div.
JOURNAL OF PHYSICS Selected Articles
23 Nov. 1964 40 p refs Transl. into ENGLISH from Wu Li Hsueh Pao (Peking), v. 19, no. 5, 1963 p 285–296
(FTD-TT-64-371/1+2+3+4; AD-609154)

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2. COLD-ROLLED AND RECRYSTALLIZATION TEXTURES OF MOLYBDENUM SINGLE CRYSTALS P.-H. Chou p 21–37 refs (See N65-20469 10-17)

N65-20468 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A STUDY OF THE PLASTIC DEFORMATION OF SINGLE CRYSTALS OF MOLYBDENUM
Pang-Hsin Chou *In its* J. of Phys. 23 Nov. 1964 p 1–20 refs (See N65-20467 10-17)

Metallographic and X-ray techniques were used to investigate 24 molybdenum single crystals of various orientations after extension at −80° (−50°), 27°, 1000°, and 2000° C. The results of investigation indicate that observable slip traces are associated with the conjugate slips on two sets of nonparallel planes along a common direction. When the actual slip planes remain the densely packed planes, the apparent slip plane varies with the orientation of a specimen. At different temperatures of extension, the apparent slip plane may or may not vary for a specimen depending on the specific orientation of the specimen. Author

N65-20469 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COLD-ROLLED AND RECRYSTALLIZATION TEXTURES OF MOLYBDENUM SINGLE CRYSTALS
Pang-Hsin Chou *In its* J. of Phys. 23 Nov. 1964 p 21–37 refs (See N65-20467 10-17)

The present work investigated the deformation and recrystallization textures in Mo single crystals of (110) [001] and (111) [11$\bar{2}$] orientations, which had been cold-rolled to 70%, 80%, and 85% reductions in thickness and subsequently annealed. It also analyzed the rotation of crystal orientation under the interaction of various slip systems during deformation of (111) [11$\bar{2}$] crystals by cold-rolling. The recrystallization textures of these crystals were observed to undergo gradual change from (22$\bar{1}$) [114] and (110) [001] to (320) [001] and (210) [001] types as the reduction in thickness was increased from 70% to 85%. Such observations can be satisfactorily explained from the viewpoint of oriented nucleation. Author

N65-20483*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SALT-STRESS-CORROSION CRACKING OF RESIDUALLY STRESSED TI-8AI-1Mo-1V BRAKE-FORMED SHEET AT 550°F (561°K)
Richard A. Pride and John M. Woodward Washington, NASA, Apr. 1965 27 p refs
(NASA-TM-X-1082) CFSTI: HC $1.00/MF $0.50

An experimental investigation of salt-stress-corrosion cracking with residual stresses was conducted with one of the supersonic-transport candidate materials, Ti-8Al-1Mo-1V. Specimens with right-angle bends were brake formed from sheet material to produce residual stresses, coated with sodium chloride, and exposed at 550° F (561° K). After various exposure times, some of the specimens were given a reverse-bend test to determine the extent of cracking based on bending deflection. Other specimens were examined metallurgically. Salt-stress-corrosion cracks began to appear in less than 20 hours, and the effects were at least as severe as the effects produced by load-induced tensile stresses. Several approaches were examined for alleviating the corrosion cracking, and, of these, shot peening and nickel plating appear promising enough to warrant further investigation. Author

N65-20537# McDonnell Aircraft Corp., St. Louis, Mo.
EVALUATION OF MOLYBDENUM (TZM) SHEET Second Quarterly Progress Report, 9 Sep.–9 Dec. 1964
R. E. Jackson 24 Dec. 1964 41 p
(Contract NOw-64-0456-c)
(BO68-2; AD-455330)

Uniform elongation tests were completed, and fabrication studies were made in the areas of joggling, corrugating, drop hammer forming (beading), dimpling, punching, and blanking. Details of the methods used and results obtained are included. Author

N65-20541# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SOME PROPERTIES OF TERNARY–β SOLID SOLUTIONS OF ZIRCONIUM WITH NIOBIUM AND MOLYBDENUM

Yu. F. Bychkov, V. V. Vlasov, and A. N. Rozanov 18 Feb. 1965 22 p refs Transl. into ENGLISH from Met. i Metalloved. Chistykh Metallov (Moscow), no. 3, 1961 p 82–95
(FTD-MT-64-423; AD-612371)

The ternary β-solid solution of zirconium alloyed with niobium and molybdenum were studied. It was shown that alloys of the system Zr–Nb–Mo, having structure of β-solid solution of increased stability, also possess good mechanical properties, heat resistance, ductility, and high oxidation resistance. Values for the yield strength, ultimate strength, elongation, and stress-rupture strength are tabulated. Also, diagrams showing the hardness of zirconium alloys during heating, and the dependence of hardness on tempering temperature are included. E.E.B.

N65-20542# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PRODUCTION OF LARGE TITANIUM ALLOY FORGINGS
B. S. Bulgakov 12 Jan. 1965 49 p refs Transl. into ENGLISH from a Russian publ., Leningrad, 1963 p 1–38
(FTD-MT-64-474; AD-612367)

The technology of titanium-based alloy forgings is presented. The basic properties of titanium alloy are compared with those for steel. One of the chief characteristics of the titanium alloy is its low specific gravity as compared to steel. Forging equipment, process development, and mechanical testing are covered. It was concluded that the mastering of large forging production of titanium alloys requires a completely different approach to the technology of forging, but the already accumulated experience is sufficient for further development of applications for large forgings, and their manufacture is possible with the present press capabilities. E.E.B.

N65-20552# Joint Publications Research Service, Washington, D. C.
EFFECT OF ELECTRIC CURRENT ON THE DIFFUSION OF IONS IN OXIDE LAYERS
F. Schein, B. Le Boucher, and P. Lacombe Huntsville, Ala., Army Missile Command, Feb. 1965 14 p refs Transl. into ENGLISH from Corrosion et Anticorrosion (France), v. 10, no. 12, 1962 p 401–407 Presented at the European Corrosion Meeting, Paris, 25 Apr.–4 May 1962
(RSIC-374; AD-612652)

A change was noted in the law of oxidation beyond a certain current density and a certain duration of electrolysis. The critical conditions of the appearance of this change were determined. The passage of a current in an oxide offers a theoretical tool for the study of oxidation processes, and furnishes a practical means for slowing down the oxidation of metals. Author

N65-20594# Alloyd General Corp., Cambridge, Mass.
EFFECT OF FLUID ENVIRONMENT ON TORSIONAL FATIGUE FAILURE Progress Report No. 3
E. F. Hutchinson and D. A. Hay 28 Dec. 1964 28 p refs
(Contract NOw-64-0248-f)
(TR-64-GRX-10; AD-455154)

This report features a study of the torsional fatigue life of quenched and tempered 52 100 test bars vs the initiation and propagation of microcracks. Replication techniques on torsional test bar gage length surfaces as a means of revealing the presence of microcracks were discarded when observations were made over the 210 000-cycle fatigue life of a specimen and cracks were identified. The microcrack systems of 52100 were found to occur in conjunction with nonmetallic stringers and to progress by connecting one stringer with the next. Ultimate fracture of 52100 bars occurs in a plane 45° from the bar axis. Microcracks in the 45° direction occur and progress as an outgrowth of established longitudinal microcracks. Author

N65-20595# Stanford Research Inst., Menlo Park, Calif.
EMBRITTLEMENT BY LIQUID METALS Summary Report, Mar. 1–Dec. 1, 1964
William R. Goggin 31 Dec. 1964 24 p ref
(Contract Nonr-4408(00))
(SRI-PMU-4925; AD-610046)

An electron microscopic investigation of the mechanics of liquid metal embrittlement is described. Specimen preparations, techniques, and tentative conclusions are reported on the aluminum–gallium couple. Author

N65-20600# General Electric Co., San Jose, Calif. Vallecitos Atomic Lab.
ELECTRON BEAM MICROPROBE STUDIES OF THE OXIDATION BEHAVIOR OF THE IRON-CHROMIUM-NICKEL SYSTEM IN HIGH-TEMPERATURE STEAM. I: TRACE INTERPRETATION TECHNIQUES
E. G. Brush Mar. 1964 57 p refs
(Contract AT(04-3)-189)
(GEAP-4490) CFSTI: $3.00

A technique developed for the interpretation of microprobe data is presented and the salient features of the probe as it relates to the iron–chromium–nickel oxidation process are discussed. Electron beam microprobe (MP) traces can play a key role in studying and interpreting the behavior of these alloys in high-temperature steam. The MP alone may not provide sufficient measurements for the evaluation of steady-state oxidation rates. Classical methods will continue to be needed. A mathematical model based on displacement reaction postulates was developed to fit the mechanistic concepts of mixed selective–nonselective oxidation phenomena. The experience of applying MP traces to the definition of the performance of the Fe–Cr–Ni alloys should be factored into a continuous refinement of the mathematical model for improved and future data interpretation. E.E.B.

N65-20642# National Gas Turbine Establishment, Pyestock (England).
A QUANTITATIVE PRESENTATION OF THE CREEP OF NIMONIC ALLOYS
K. F. A. Walles London, Min. of Aviation, Mar. 1959 69 p refs
(NGTE-NT-386)

A previously derived creep formula is shown to represent the creep of Nimonic alloys to within the scatter of the experimental data, this scatter being indicated by the analysis and confirmed by the results of replicate tests under the same conditions. The formula is further supported by the agreement with experiment, to within the same scatter, of extrapolated values. A summary with examples is given. Author

N65-20699 Timken Roller Bearing Co., Canton, Ohio. Steel and Tube Div.
RESUME OF INVESTIGATIONS ON STEELS FOR HIGH-TEMPERATURE, HIGH-PRESSURE APPLICATIONS, 1963–1965
Claude L. Clark [1965] 151 p

Research and development activities centered on the following subjects: (1) *Laboratory Tests for Confirming Expected High Temperature Strength Properties*—properties in

the elastic and in the plastic range; (2) *High Temperature Properties of Type 304L Austenitic Steel with Controlled Residual Elements*—addition of residual elements to impart high grade temperature properties; (3) *High Temperature Properties of TP 316 Plus Columbium*—addition of columbium to impart high grade temperature properties; (4) *Are the Minimum Specified Tensile Requirements of ASTM Specifications too Conservative?*—reduction of some specified minimum values for pipe materials; (5) *High Temperature Testing Facilities in the Canton Laboratories;* (6) *Short-Time High Temperature Tensile Properties of Designated Steels;* (7) *Misconceptions Regarding High Temperature Properties and Data;* (8) *A 9% Chromium–1% Molybdenum Steel with Improved High Temperature Strength Properties;* and (9) *Bibliography of Previous Résumés.* G.G.

N65-20703# Linde Co., Indianapolis, Ind. Speedway Labs.
FABRICATION AND PROPERTIES OF TUNGSTEN SINGLE CRYSTALS. GROWTH OF SINGLE CRYSTAL TUNGSTEN TO BE USED FOR ROLLING INTO SINGLE CRYSTAL SHEET Quarterly Progress Report, Sep.1–Nov. 30, 1964
F. R. Charvat, G. W. Edwards, and J. W. Arthur 28 Dec. 1964 26 p refs
(Contract NOw-64-0055-c)
(QPR-3; AD-456521)

Six high purity tungsten and two tungsten–0.6% niobium crystals, selected on the basis of minimum crystal misorientation, were machined into rectangular billets. The ability and feasibility of fabricating single tungsten crystal sheets from the large as-grown single crystals were investigated, and studies of the substructural changes accompanying deformation through rolling at 1000° C were made on four crystallographic combinations of rolling plane and rolling direction. Measurements of strength, ductility, and macroscopic dimensional changes of the billet during rolling have been completed and slip trace analysis established the $<111>\{11\bar{2}\}$ as the primary slip system. Rolling parameters have been evaluated and related to the lattice bending introduced into the crystals during rolling. Preliminary recrystallization studies indicate a strong dependence of the recrystallization temperature on processing techniques. G.G.

N65-20710# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.
STRESS CORROSION CRACKING OF AUSTENITIC STAINLESS STEEL Status Report, September 1, 1964
Mc Intyre R. Louthan, Jr. Feb. 1965 22 p refs
(Contract AT(07-2)-1)
(DP-957) CFSTI: $1.00

Stress corrosion cracking of austenitic stainless steel is being investigated to develop a fundamental understanding of the phenomenon. This report presents the status of studies relating specimen microstructure and dislocation substructure to the susceptibility to stress corrosion cracking. Anodic dissolution plays a major role in the nucleation and propagation of stress-corrosion cracks. The susceptibilities of different heats of the same type of steel to cracking are quite different, and these differences are not attributable to differences in the composition of major alloying elements, material hardness, or dislocation substructure. It is also shown that the relative rate of preferential attack at dislocation arrays and stacking faults in thin foils of type 304 stainless steel exposed to dilute NaCl solutions increased with increasing temperature and was more rapid in heats of steel which were most susceptible to cracking in bulk tests. Author

N65-20725# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center
OXIDATION-RESISTANT COATINGS FOR REFRACTORY METALS
J. J. English 19 Mar. 1965 2 p refs

The evaluation of coated refractory-metal foils revealed that Cr–Ti–Si coated B-66 foil was believed to have the best potential for use as heat-shield panels. Results from oxidation tests showed that the slurry coating of Cr–Ti–Si is comparable to vacuum-pack-applied coatings. Excessive interdiffusion between 3-mil platinum coatings and TZM or FS-85 substrates was found to limit the protective lives to 5 to 15 hours at 2550° F. Studies for the improvement of the ductility of protective coatings and of silicide coatings; the development of slurry coatings for columbium, tantalum, and molybdenum; and the measurement of thermal expansion of various silicide compounds are reported. Further, pack-cementation silicide coating was found to protect 20-mil V–60Cb–Ti alloy from oxidation for 25 4-hour cycles at 2300° F in static laboratory air. E.E.B.

N65-20734# Royal Aircraft Establishment, Farnborough (England).
THE SURFACE SELF-DIFFUSION OF COPPER AS AFFECTED BY ENVIRONMENT
F. J. Bradshaw, R. H. Brandon, and C. Wheeler London, Min. of Aviation, Apr. 1964 29 p refs
(RAE-TN-CPM-66)

Using mass-transfer methods, the surface self-diffusion of copper has been shown to depend on environment. An increase of oxygen pressure increases the surface diffusion rate, but interpretation on the basis of adsorbed oxygen is not simple. There was evidence of impurity effects in hydrogen environments, with measurements in vacuo being the most consistent. Between 800° and 400° C diffusion occurred with an activation energy (~20 kcals) lower than that previously reported for temperatures above 800° C. Author

N65-20747# Royal Aircraft Establishment, Farnborough (England).
THERMOCOUPLES, A CRITICAL SURVEY
B. F. Billing London, Min. of Aviation, May 1963 44 p refs
(RAE-TN-CPM-18)

Data on commercially available thermocouple materials are summarized. Additional calibrations were made at low temperatures to supplement or comment on existing data. Physical properties significant in the selection of thermocouple wires were tabulated. Author

N65-20764# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ANALYSIS OF CONDITION RELATED TO HIGH-TEMPERATURE DEFORMATION OF HIGH-MELTING METALS
V. L. Orzhekhovskiy, I. M. Pavlov et al 9 Jan. 1965 9 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Chern. Met. (Moscow), no. 9, 1963 p 88–91
(FTD-TT-64-595/1+2; AD-610291)

Heating, rolling, and cooling of metals were investigated in air, in vacuum, and in an argon atmosphere. The metal rolled in a vacuum was shown to have higher deformation and better mechanical properties than the metal rolled in an ordinary atmosphere. This difference was connected with the absence of gas saturation and partial cleaning of the metal. In the case of hot rolling of molybdenum and niobium in a vacuum there was an absence of oxidation, leading to an increased coefficient of friction, expansion, and weight, as compared

with the rolling in air. High temperature deformation in vacuum led to a notable increase in the plastic properties of the metal and made it possible to carry on further processing at a lower temperature. E.E.B.

N65-20766# Aeronautical Research Labs. Melbourne (Australia).
STEELS FOR HIGH SPEED FLIGHT
R. Oppenheim Aug. 1964 24 p refs Transl. into ENGLISH from Jahr. Wiss. Ges. Luftfahrt (Berlin), 1959 p 376–383
(ARL/SM-22)

The low-alloy high strength steels, heat-treatable 12% chromium steel, hot work tool steels, cold-rolled austenitic stainless steels, precipitation-hardenable stainless steels and the austenitic age-hardening steels are discussed with reference to their use as materials for supersonic aircraft construction. In addition to elevated temperature properties and stress-rupture strengths, details of the behavior of the various steels when being formed, machined and heat-treated are discussed and problems of distortion, brazability and weldability, as well as corrosion and oxidation resistance, are considered. Some examples are given of the use of these steels in modern aircraft and missiles. Author

N65-20786# Battelle Memorial Inst., Columbus, Ohio. Nonferrous Metallurgy Div.
FURTHER DEVELOPMENT OF A DUCTILE TUNGSTEN-BASE SHEET ALLOY Quarterly Progress Report, Aug. 19–Nov. 19, 1964
J. L. Ratliff, W. H. Abbott, D. J. Maykuth, H. R. Ogden, J. M. Blocher, Jr. et al 19 Dec. 1964 23 p refs
(Contract N600(19)61982)
(QPR-2; AD-454869)

Processing studies were conducted in an effort to develop new and improved ways of accomplishing ThO_2 dispersion in W–5Re–2.2ThO_2. Promising results which indicated improvements in ductility over the standard nitrate preparation were obtained by preparing the alloy from a ThO_2 solution. Fractographic studies were conducted on a tensile specimen of W–5Re–2.2 ThO_2 which showed 12% elongation when tested at 0° C. Results indicated that the tensile ductility was derived from inhibited crack propagation. Author

N65-20790*# Union Carbide Corp., Parma, Ohio. Carbon Products Div.
HIGH TEMPERATURE PROTECTIVE COATINGS FOR REFRACTORY METALS Progress Report No. 1, Oct. 23, 1964–Jan. 23, 1965
E. B. Bitzer, J. Rexer, and R. G. Fenish [1965] 29 p refs
(Contract NASw-1030)
(NASA-CR-57768) CFSTI: HC $2.00/MF $0.50

A program was initiated to establish the feasibility of using iridium as a protective coating for unalloyed columbium and tantalum. Iridium provides remarkable protection to graphite at temperatures of 2000° C. The program encompasses a study of methods of applying iridium to the refractory metal substrate, investigation of the chemical and mechanical compatibility of the coating-substrate system, and limited oxidation studies. Electrodeposition of iridium on the substrate appears the most promising method of sample preparation. Study of the effect of chemical interaction on the mechanical behavior of the coating-substrate systems was initiated using roll bonded, pressure bonded, and refractory metal plated samples of iridium. A microbend test was used to observe continuously the microstructure of coated samples loaded to fracture. Author

N65-20802*# Manlabs., Inc., Cambridge, Mass.
DEVELOPMENT OF STRESS RELIEF TREATMENTS FOR HIGH STRENGTH ALUMINUM ALLOYS Quarterly Progress Report No. 4, 1 Sep.–30 Nov. 1964
Dec. 1964 24 p
(Contract NAS8-11091)
(NASA-CR-57649) CFSTI: HC $1.00/MF $0.50

The large differences in the maximum residual stress values previously noted between rolled and forged 7075-T6 plate materials is being investigated. Preliminary results indicate that these differences are due, at least in part, to heat treating variables. The residual stress relieving characteristics of 7178-T6 forged plate are almost identical to those of rolled 7075-T6 plate. Residual stress distributions in 7178-T6 forgings in three thicknesses were determined. Section thickness was shown to have little effect on the maximum values of residual stress. A different specimen for the more economical measurement of residual stress relief, using cut and deflection measurement techniques, is being evaluated. Preliminary results indicate fair agreement with those obtained by previously employed techniques. Author

N65-20838# Los Alamos Scientific Lab., N. Mex.
THE OVERDRIVING EFFECT IN DYNAMIC POLYMORPHISM
T. R. Loree, F. S. Minshall, and D. Stirpe 24 Mar. 1965 22 p refs
(Contract W-7405-ENG-36)
(LA-3215) Available from AEC, Oak Ridge, Tenn.: $2.00

In some materials the transition pressure observed in dynamic studies of polymorphism is dependent upon sample thickness and input pressure. Experimental investigations of this overdriving effect are presented for three materials: the binary alloy 20 wt% nickel in iron, which shows no effect; 20 wt% chromium in iron, in which a strong effect is seen; and 4340 steel of various hardnesses, in which the effect varies with hardness. A model is proposed for the case in which the transition pressure decays as the sample thickness is increased. Author

N65-20878*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STUDIES OF FATIGUE CRACK GROWTH IN ALLOYS SUITABLE FOR ELEVATED-TEMPERATURE APPLICATIONS
C. Michael Hudson Washington, NASA, Apr. 1965 27 p refs
(NASA-TN-D-2743) CFSTI: HC $1.00/MF $0.50

Constant-amplitude axial-load fatigue-crack-propagation tests were conducted on 8-inch (20.3-cm) wide sheet specimens made of AM 350 (CRT) and AM 367 stainless steels, two thicknesses of Ti–8Al–1Mo-1V (duplex annealed) titanium alloy, 2020-T6, 2024-T81 (clad), and RR-58 (clad) aluminum alloys, and Inconel 718 superalloy. Tests were conducted at room, elevated, and cryogenic temperatures to determine the effect of temperature on crack propagation. The fatigue-crack-growth resistance of the materials was determined and compared with materials tested similarly in a previous investigation. At elevated temperature, the 0.050-inch (1.27-mm) thick titanium alloy, Ti–8Al–1Mo-1V, in either the duplex- or triplex-annealed condition showed the greatest resistance to crack growth. At the room and cryogenic temperatures, the superalloy Inconel 718 appeared the most resistant. The AM 367 stainless steel showed good resistance to crack growth at all temperatures. Author

N65-20885*# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
DETERMINATION OF THE WELDABILITY AND ELEVATED TEMPERATURE STABILITY OF REFRACTORY METAL ALLOYS Quarterly Report No. 6, 21 Sep.–20 Dec. 1964
G. G. Lessmann and D. R. Stomer [1965] 60 p refs
(Contract NAS3-2540)
(NASA-CR-54301; WANL-PR-(P)-006) CFSTI: HC $3.00/MF $0.50

The procurement phase is reported as essentially complete. Also, the sheet butt weld parameter study was completed for all available niobium and tantalum alloys and for W-25Re electron beam welds. Bend test results are summarized. The bead-on-plate weld restraint patch tests showed that these welds were defect free as determined by visual, radiographic and penetrant inspections. Transverse and longitudinal specimens of Ta-10W, SCb-291, Cb-752, C-129Y, D-43, B-66, and FS-85 3/8 inch butt welds were bend tested. Both transverse and longitudinal specimens of Ta-10W, FS-85, and SCb-291 displayed excellent ductility although the longitudinal specimens of FS-85 and SCb-291 failed at 125° and 160° bend angles. The longitudinal specimen of C-129Y was bent through 132° without failure but the transverse specimen failed at 27°. The other alloys had poorer ductility. Oxygen concentration in the as-backfilled chamber was less than 0.25 ppm with a total active impurity concentration of less than 1.25 ppm. E.E.B.

N65-20914# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NICKEL BASE HEAT RESISTANT ALLOYS
Jan Chodorowski 16 Mar. 1965 19 p refs Transl. into ENGLISH from Tech. Lotnicza (Poland), no. 7, 1963 p 183–188
(FTD-TT-64-707/1+2; AD-460178)

A review of the literature on nickel base heat-resistant alloys is presented. The chemical composition of cast heat-resistant alloys, the effects on the mechanical properties of nickel alloys by addition of various elements, equilibrium diagram of the pseudotertiary system Ni_3Cr–Ni_3Al–Ni_3Ti, and change in size of phase separations with aging are covered. It was concluded: (1) additive elements do not uniformly affect the physical and mechanical properties of nickel alloys; (2) the degree of stress increases with increasing difference in atomic diameters between additive element and basic solution; (3) the farther an additive element is from nickel in the periodic table, the greater is its effect on deformation of crystal lattice of the solid solution; and (4) high hardening of solid nickel solutions can be attained by raising the degree of deformation of the crystal lattice by introduction of certain elements. E.E.B.

N65-20923# Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy
EFFECTS OF PROCESSING HISTORY ON FRACTURE AT HIGH STRENGTH LEVELS Technical Report, 1 May 1962–31 Jul. 1964
M. Azrin, M. L. Ebner, D. R. Poirier, W. A. Backofen, and M. C. Flemings Wright-Patterson AFB, Ohio, AF Mater. Lab., Feb. 1965 42 p refs
(Contract AF 33(657)-9169)
(AFML-TR-64-376; AD-459453)

A study was made of the effect of processing history on the fracture toughness of quenched and tempered (at 400° F) AISI 4340 steel. Precracked Charpy specimens of 0.100-inch thickness were used to evaluate the plane-stress fracture toughness, the value being expressed as W–A (energy absorbed/minimum specimen cross section). Four different ingot structures were obtained in air-melted material by casting into (1) a cast-iron mold, (2) a mold that produced unidirectional solidification, (3) a sand mold, and (4) a mold lined with exothermic material. The fracture toughness of the heat-treated ingot material at 70° F was about 450 in.-lbs/in.^{2} independent of the microporosity volume and average inclusion size, both of which were increased as solidification time was lengthened. Six other heats were melted and poured in an induction furnace allowing control of atmosphere, either vacuum or gaseous. With carbon in the range of 0.36 to 0.44 wt%, the fracture toughness of vacuum-melted material at 70° F was 1200 to 800 in.-lbs/in.^{2}, significantly higher than that of air-melted material of similar carbon content. With an increase in carbon to 0.47 wt%, fracture toughness was lowered to 300 in.-lbs/in.^{2}. Aluminum nitride was identified with a large part of the difference resulting from the two melting practices. When the concentration product of acid-soluble aluminum and nitrogen (both in ppm) was below 15000, the room-temperature fracture toughness in cast material was above 800 in.-lbs/in.^{2}. Author

N65-20985*# Battelle Memorial Inst., Columbus, Ohio.
THE FATIGUE BEHAVIOR OF MATERIALS FOR THE SUPERSONIC TRANSPORT
M. S. Healy, C. W. Marshall, F. C. Holden, and W. S. Hyler Washington, NASA, Apr. 1965 94 p refs
(Contract NASr-100-(01))
(NASA-CR-215) CFSTI: HC $3.00/MF $0.75

Tests were conducted on sheet specimens of two materials, Ti-8Al-1Mo-1V and AM350 CRT to determine the fatigue lives, rates of fatigue-crack propagation, and residual static strengths at three temperatures, 550° F, −110° F, and room temperature. The effects of prior exposure to 550° F for up to 10000 hours on the same properties were also studied. Neither material was significantly degraded by the elevated temperature soak. The fatigue characteristics were found to be comparable to those of contemporary aluminum alloys. Author

N65-21002*# National Aeronautics and Space Administration, Washington, D. C.
PREPARATION AND PHYSICAL PROPERTIES OF REFRACTORY CARBIDES [POLUCHENIYE I FIZICHESKIYE SVOYSTVA TUGOPLAVKIKH KARBIDOV]
K. A. Nikitin, G. A. Bergman, and V. A. Nikolayeva Apr. 1965 5 p Transl. into ENGLISH from Teplofiz. Vysokikh Temperatur (USSR), v. 2, no. 1, 1964 p 130–131
(NASA-TT-F-9315) CFSTI: HC $1.00/MF $0.50

A seminar on the preparation, and the thermodynamic and other physical properties of carbides of refractory metals, silicon, and boron is discussed. The use of the characteristic feature of the electron energy spectrum in the crystal lattices of carbides as a classification criterion for the refinement of existing classification was recommended. Reports were presented on preparation of carbides, particularly carbides of silicon and titanium, rare earth elements, binary carbides, cermets–zirconium dioxide and carbides of titanium, and niobium. Also, the phase diagrams of binary and ternary systems of Ti–C and Bn–C were presented. The diffusion of carbon into metals, the equilibria between the titanium nitrides, the carbon reactions with zirconium and hafnium, and the diffusion welding of carbides to refractory metals were included. The thermoemissive properties of carbides, vaporization of refractory metal carbides, and the thermodynamics of carbides of variable composition were discussed. E.E.B.

N65-21032# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TITANIUM AND HYDROGEN

Yu. V. Baymakov and O. A. Lebedev 13 Jan. 1965 18 p refs Transl. into ENGLISH from Tr. Inst. Politeknicheskiy (Leningrad), no. 223, 1963 p 25–34
(FTD-MT-64-317; AD-613519)

Interaction of hydrogen and titanium was studied experimentally. Laboratory methods, which are described in detail, involve heating gaseous hydrogen and titanium either in powder or rod form, and heating titanium hydride. Various reaction parameters were measured as a function of heating time. These parameters include reaction temperature for titanium powder and hydrogen, hydrogen content in both titanium powder and rod, and decomposition rate of titanium hydride. Elasticity of dissociation of titanium hydride was determined as a function of heating temperature. Values of free energy of formation of titanium hydride are listed. J.M.D.

N65-21045# Atlantic Research Corp., Alexandria, Va.
BEHAVIOR OF NOZZLE MATERIALS UNDER EXTREME ROCKET MOTOR ENVIRONMENTS Quarterly Progress Report, Nov. 1964–Jan. 1965
J. D. Batchelor Mar. 1965 21 p
(Contract NOw-64-0393-c)
(QPR-3; AD-612657)

Experimental reaction studies were continued using two techniques with the plasma torch heat source. The test technique which exposes the bore of a tubular specimen to a high heat flux and a high velocity of selected gas mixtures was used with graphite, hafnium carbide, and niobium carbide. Weight changes and dimensional changes in the bore of the specimens were measured. Weight changes are affected by losses which occur at the ends of specimens which appear to be edge effects. Beyond this, for hafnium carbide the formation of a refractory oxide reaction product can lead to weight increases and reduction in bore diameter if the oxide is not removed, or to weight loss and increase in bore diameter if the oxide is removed. Tables are included to show the results of these competing effects. Also, test data by the impingement technique for pyrolytic graphite coated hemispheres are included. E.E.B.

N65-21051# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center
DEPARTMENT OF DEFENSE REFRACTORY METALS SHEET ROLLING PROGRAM Status Report No. 3, Jun. 1962–Nov. 1, 1964
Daniel J. Maykuth 26 Jan. 1965 41 p refs
(Contract AF 33(615)-1121)
(DMIC-212; AD-612490)

Contracts involving powder-metallurgy tungsten, Mo–0.5Ti, TZM, and the D-43 alloys have been completed. At least 10 sheets of each alloy were produced in 2 or more gages from 0.010 to 0.25 inch, in widths from 14 to 24 inches, and in lengths from 30 to 96 inches. Most of this production sheet had a flatness of 4% or less and showed good uniformity of properties within individual sheets as well as from sheet to sheet. Sheets of the tungsten and TZM alloy are being further evaluated. Four pilot sheet-rolling programs on the Cb–5Mo–5V–1Zr (B-66), Cb–27Ta–10W–1Zr (FS-85), Ta–7W–3Re (GE-473), and Ta–9.6W–2.4Hf–0.01C (T-222) alloys also were completed. Author

N65-21058# Brush Beryllium Co., Cleveland, Ohio.
INVESTIGATION OF THE MECHANICAL CHARACTERISTICS OF ZONE-LEVELED BERYLLIUM Technical Report, 1 Jan.–30 Sep. 1964
J. A. Carrabine, A. J. Stonehouse, D. G. Fetsko, and W. W. Beaver Wright-Patterson AFB, Ohio, AF Mater. Lab., Jan. 1965 68 p refs
(Contract AF 33(615)-1177)
(BBC-TR-376-244; AFML-TR-64-388; AD-612696)

Zone-leveling produces beryllium single crystals of intermediate purity, having moderately high basal glide capacity, while retaining reasonably high strength. Properties of the zone-leveled crystals are dependent upon zone travel rate, but not upon the number of zone passes. The enhanced basal glide corresponds to an agglomeration of insoluble impurities, and a retention of the soluble elements in solid solution. The process results in some bulk purification, but does not alter significantly the plastic anisotropy of the crystals. Application of the zone-leveling concepts, in a modified manner, to commercial hot-pressed polycrystalline metal resulted in an improvement in room-temperature tensile elongation, with only minor strength alterations. The implication of these results is that a refinement of the thermal and chemical parameters involved in the process could possibly lead to a materially improved engineering metal of available purity, thus precluding the high-purity approach. Author

N65-21082# Battelle Memorial Inst., Geneva (Switzerland).
THE EFFECT OF SMALL ALLOY ADDITIONS ON THE PROPERTIES OF DISLOCATIONS IN α-IRON
D. G. Brandon, R. Anderson, and J. Spreadborough Brussels, EURATOM, Nov. 1964 22 p refs Presented at the Faraday Soc. Gen. Discussion on: Dislocations in Solids, Göttingen, Germany, 15–17 Sep. 1964
(Contract EURATOM-095-62-12 RDS)
(EUR-1750.e; EURAEC-1075) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 40 Belg. Fr.

The temperature and strain rate dependence of the flow stress was measured for Armco iron and its dilute alloys with silicon, chromium and manganese. The results cannot be accounted for simply in terms of thermally activated dislocation movement through a distribution of rigid potential barriers in the annealed matrix, but require that the workhardening contribution to the flow stress should also be temperature dependent. These results are supported by a thin-film electron microscope study of the dislocation structure and dislocation density after deformation at room temperature. Most of the observed effects can be explained if the primary barriers to dislocation movement at low temperatures are interstitial clusters and single interstitial atoms. Author

N65-21095# Rocketdyne, Canoga Park, Calif. Research Dept.
APPLICATION OF THIN-FILM ELECTRON MICROSCOPY TO REFRACTORY METAL PROCESSING Quarterly Progress Report, 12 Sep.–11 Dec. 1964
R. P. Jewett 11 Jan. 1965 22 p refs
(Contract NOw-64-0299-d)
(R-5776-3; AD-455331)

The results of a program to correlate refractory metal deformation and fine structure effects as observed by transmission electron microscopy are presented. The first experimental phase of the deformation of tantalum and tantalum–10% tungsten is complete. Deformation of molybdenum and TZM by cold-rolling at room temperature is completed. Author

N65-21101# Brush Beryllium Co., Cleveland, Ohio.
DEVELOPMENT OF VERY HIGH STRENGTH BERYLLIUM WIRE Final Report
E. A. Murphy and R. G. O'Rourke 7 Dec. 1964 61 p refs
(Contract NOw-64-0162-c)
(BBC-TR-382-243; AD-610316)

Results of a program of development of a process to produce high-strength beryllium fine wire are described. The beryllium–iron alloys could not be deformed at temperatures used for the warm drawing technique. It was found that the 2% copper level gives improved mechanical properties to extruded forms over the 5% copper level. Both copper beryllium alloys showed very poor strain-hardening characteristics during the warm drawing operation. The drawability of the fine grained materials from the same starting material was found to decrease with decreased grain size with increased oxide content. A 15% increase in tensile strength with a substantial increase in wire ductility at 0.00477-inch diameter was shown for wire, as-drawn from 0.210-inch diameter, from starting material having −20 +10 micron particle size. Similar strength levels with excellent ductility were obtained with high purity −15 +1 electrorefined material at wire sizes of 0.001278-inch diameter. A 25% increase in tensile strength was obtained after pickling. Author

N65-21106# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE CELLULAR STRUCTURE OF THICK-LAYERED ANODIC OXIDE FILMS
N. D. Tomashov and F. P. Zalivalov 9 Jan. 1965 13 p refs Transl. into ENGLISH from Korroziya Metallov i Splavov (Moscow), 1963 p 194–202
(FTD-TT-64-598/1+2; AD-610343)

A quantitative study of the relationship between the thickness of the oxide film anodically formed on the surface of aluminum and its alloys and the dimensions of the individual oxide cells composing the film is described. An equation is derived which expresses the basic ratio that determines such structural parameters of a thick (25 to 200 microns) film as the size of the cell and the thickness of the barrier layer. The ultimate orderly cellular structure of the film results from both compaction of the original disoriented cells during the initial formation of the porous part of the film and from blending of some disoriented cells to form one cell whose dimensions are governed by the geometrical arrangement. Such reorganization results in a strictly orderly arrangement and corresponds to structural stabilization of the anodic film. M.P.G.

N65-21107# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF THERMOMECHANICAL TREATMENT ON SUSCEPTIBILITY TO TEMPERING BRITTLENESS
L. G. Sakvarelidze and F. N. Tavadze 31 Dec. 1964 12 p refs Transl. into ENGLISH from Tr. Inst. Met., Akad. Nauk Gruz. SSR, v. 12, 1962 p 159–165
(FTD-TT-64-609/1+2; AD-610293)

Two low carbon steel alloys were investigated for susceptibility to tempering brittleness. The grain boundaries of the samples in the state of irreversible annealing brittleness after hardening and single annealing at 500° C consist of a mixture of ferrite and finely dispersed cementite particles. The cause of irreversible annealing brittleness may be irregular distribution of carbide phase, which can be alleviated by thermomechanical treatment. Hardening from forging hinders the occurrence of irreversible annealing and leads to a sharp rise in impact tenacity. Thermomechanical processing also eliminates the so-called substructure of austenite pseudograin, concentrating it on the surface enveloped in fine grain crystallites. Thermomechanical processing promotes reduction in the true cold brittleness threshold of malleable samples and reduction in the transient temperature of brittle samples. E.P.V.

N65-21128# New York Univ., N. Y. Research Div.
DEVELOPMENT OF TOUGH, HIGH STRENGTH ALPHA BETA TITANIUM-BASE ALLOYS AT 240,000–260,000 PSI YIELD STRENGTH LEVEL Quarterly Progress Report No. 7, Dec. 26, 1963–Mar. 25, 1964
P. A. Farrar and H. Margolin [1964] 23 p refs
(Contract DA-30-069-ORD-3690)
(WAL-TR-401/303-6; AD-609905)

To develop titanium alloys with higher ductilities and 0.1% yield strengths in the range of 190 000 to 240 000 psi and usuable ductility in the range from 240 000 to 260 000 psi, 30 8-lb ingots were investigated. Four alloys which showed promising properties in the 190 000- to 240 000-psi range as 8-lb ingots were remelted as 80-lb ingots for further evaluation as bar, plate and sheet material. Tensile tests at room temperature and −40° F impact tests were completed for three of the alloys at different heat treatments and the data are tabulated. Author

N65-21135# Bureau of Mines, Boulder City, Nev.
ELECTROREFINING BERYLLIUM: TWO-CYCLE ELECTROLYSIS
M. M. Wong and D. A. O'Keefe 1964 12 p refs
(BM-RI-6570)

To obtain beryllium metal of higher purity, flakes produced from electrorefining scrap metal were used as cell feed for a second cycle of electrorefining at 500° C in an electrolyte composed of 51.7 mole percent LiCl, 36.9 mole percent KCl, and 11.4 mole percent $BeCl_2$. Metallic impurities in the flakes totaled more than 108 ppm, the metallic impurities in the metal obtained from the two-cycle electrorefining were, with the exception of 35 ppm of calcium, below the spectrographic determination limits. Author

N65-21137# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center
TITANIUM AND TITANIUM ALLOYS
R. A. Wood 2 Apr. 1965 6 p refs

Recent developments in titanium and titanium alloys are surveyed; these include derivation of a partial titanium–aluminum phase diagram, evaluation of new candidate alloys for high-temperature service and Navy thick-plate applications, scaling-up of production of very high strength alpha-beta alloys, development of a compound-free beta alloy, and continuation of a program to develop a stable beta alloy utilizing the principal of intermetallic compound precipitation to achieve strengthening. M.P.G.

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N65-20410# General Dynamics/Astronautics, San Diego, Calif.
THERMOPHYSICAL PROPERTIES OF PLASTIC MATERIALS AND COMPOSITES TO LIQUID HYDROGEN TEMPERATURE (−423° F) Quarterly Progress Report No. 8, 1 Aug.–1 Nov. 1964

Malcolm D. Campbell, Gerald L. O'Barr, and Julius Hertz [1964] 35 p
(Contract AF 33(657)-9160)
(BVJ-63-001-8)

Thermophysical property information at cryogenic temperatures is reported for plastic materials and composites whose properties at room temperature and above are known. The coefficient of thermal expansion, specific heat, density, and thermal conductivity were measured at temperatures from −423° F to room temperature. Data are tabulated. E.E.B.

N65-20523# General Dynamics/Fort Worth, Tex.
EFFECTS OF REACTOR RADIATION AND TEMPERATURE EXPOSURE ON A SOLID POLYURETHANE ELASTOMER AND A POLYURETHANE FOAM Final Report, 1 Oct. 1963–30 Sep. 1964
P. M. Johnson, J. H. Lewis, and M. R. Self Kirtland AFB, N. Mex., AF Weapons Lab., Dec. 1964 100 p refs
(Contract AF 29(601)-6213)
(FZK-195; WL-TR-64-131; AD-612466)

A polyurethane elastomer and foam were irradiated to six gamma dose levels in the range of from 3×10^8 to 9×10^{10} ergs/gm(C) at 75° and 240° F. The elastomer was irradiated as tensile specimens and compressed buttons and the foam was irradiated as compressed and uncompressed buttons. Tensile properties, hardness, compression set, weight change, and specific gravity were measured for the elastomer. Compression set, compression load deflection, and density were measured for the foam. The data were analyzed by several theoretical and empirical equations to obtain molecular interpretation of the radiation effects. Molecular weight between cross-links, based on stress–strain data for the elastomer, and the rate constant for chain cleavage from stress relaxation in the foam were obtained as a function of radiation dose. Also, the network chains effective in creating compression set were calculated for both materials. The elastomer is considered radiation-resistant up to a dose of 10^{10} ergs/gm(C). The foam appears to be a favorable material for use in the radiation fields at moderate temperature and dose. Author

N65-20577 Joint Publications Research Service, Washington, D. C.
PRODUCTION OF ALUMINA CEMENT BY SINTER PROCESS IN CONVERTER
Wan-hsin Tso, Yu-yun Wang, Hsiu-ch'un Hu, and Ch'i-liang T'ien *In its* Transl. on Communist China's Sci. and Technol., No. 156 9 Mar. 1965 p 4–24 refs Transl. into ENGLISH from K'o Hsueh T'ung Pao (Peiping), no. 1, 17 Jan. 1965 p 56–64 Presented at the Peking Sci. Symp., 1964 (See N65-20576 10-06) CFSTI: $4.00

Dry-process sintering of alumina cement, using existing silicate cement plant equipment, is lower in power cost than electric furnace, hochofen, or smelt processes. Raw material low in iron content is required to overcome problems of narrow sintering temperature range, ring formation in the kiln, and formation of lumps in the roasted material. The major water-hardening minerals in the product, calcium aluminate and calcium dialuminate, provide excellent gelling properties. Alumina cement finer than #400 may be produced by mixing alumina of aluminum oxide–silicon oxide ratios equal to or greater than seven, with other raw materials of suitable quality. E.P.V.

N65-20627# Air Force Systems Command, Wright-Patterson AFB, Ohio. AF Materials Lab.
TECHNOLOGY OF NEW DEVITRIFIED CERAMICS—A LITERATURE REVIEW
Barry R. Emrich (M.S. Thesis–Ohio State Univ.) Sep. 1964 162 p refs
(ML-TDR-64-203; AD-608217)

The devitrified ceramics of primary concern are those materials which are predominantly crystalline bodies produced by induced and controlled nucleation and crystallization of preformed glass articles. Information is presented on compositional and processing factors; fundamental phenomena; properties; the effects of crystal size, heat treatment, and composition on properties; and applications. It also includes selected abstracts. It is concluded that devitrified ceramics are in their infancy and that there is an urgent need for further development and understanding of fundamental characteristics in order to realize the full potential of these relatively new ceramic materials. Author

N65-20629# Royal Aircraft Establishment, Farnborough (England).
AN INVESTIGATION INTO SOME OF THE FATIGUE AND CREEP PROPERTIES OF VACUUM MOULDED "DURESTOS"
P. L. Mc Mullen London, Min. of Supply, Mar. 1952 22 p refs
(RAE-TN-CHEM-1166)

Indications are that, in tension, "Durestos" has a virtually indefinite life when the maximum alternating stress does not exceed 10 000 lb/in^2; the safe life at this stress is 40×10^6 stress cycles. For a similar life the corresponding figure for a high strength (32 ton) aluminium alloy is 39 000 lb/in^2. When subjected to pulsating compression it is probable that "Durestos" has a life in excess of 20×10^6 stress cycles when the maximum alternating stress does not exceed 12 000 to 12 500 lb/in^2 which is equivalent to 80% to 83% of the ultimate compressive strength. The results of some pulsating tension tests on bolt hole test pieces made in "Durestos" are also included as well as results of pulsating tension tests in which it was arranged that the core and glue line of test pieces cut from "Durestos" sandwich materials were subjected to repeated shear. Author

N65-20630# Royal Aircraft Establishment, Farnborough (England).
THE TENSILE FATIGUE PROPERTIES OF VACUUM MOULDED "DURESTOS"
D. J. Mc Cue London, Min. of Supply, Aug. 1958 10 p ref
(RAE-TN-CHEM-1334)

The life of vacuum-molded "Durestos" under conditions of sustained loading (P ±0) and of fluctuating tension at P ±1/2P was reported. To extend the range of application, supplementary tensile fatigue tests were carried out at P ±1/3P and P ±0.9P. The results are reported, with a discussion of general features of the stress-life curves obtained. At a maximum stress of 45% of the ultimate strength, vacuum-molded "Durestos" appears to have an indefinite life for all values of minimum stress in the tensile range. Author

N65-20631# Royal Aircraft Establishment, Farnborough (England).
PROTECTIVE SCREENS FOR LABORATORY USE
I. B. Mowat London, Min. of Supply, Sep. 1950 8 p
(RAE-TN-CHEM-1135)

Tests were made on transparent plastic materials to ascertain their resistance to shattering by explosions in adjacent glass apparatus. Perspex and cellulose acetate were used, the materials being exposed to flying glass fragments produced by the explosion of hydrogen–oxygen and acetylene–oxygen mixtures in glass flasks. In addition, cellulose acetate

was tested to ascertain its ability to withstand the explosions of service detonators at close quarters. As a result of the experiments, cellulose acetate sheet 0.12 in. (3 mm) thick is recommended as a screening material for general chemical laboratory use. A simple type of light screen incorporating this material is described. Author

N65-20632# Royal Aircraft Establishment, Farnborough (England).
PRESENT AND POTENTIAL FATIGUE AND CREEP STRENGTHS OF REINFORCED PLASTICS
R. B. Heywood London, Min. of Aviation, Oct. 1958 39 p refs
(RAE-TN-CHEM-1337)

A review is given of available information on fatigue and creep strengths of glass- or asbestos-reinforced plastic materials, dealing mainly with room temperature properties. The subject is subdivided into the following categories: testing methods, material research, and design data. New special-purpose equipment is required in order to overcome certain difficulties associated with fatigue testing of fiber-reinforced materials. Several material factors which may influence strength are considered in the light of available information. The differences between the behavior of bulk glass and of reinforced plastics lead to suggestions as to the potential or ideal fatigue and creep strengths of reinforced plastics. The type of data required by the designer, and the effect of variables with which he may have to deal are discussed, and good and bad properties of reinforced plastics from the point of view of their use in aircraft are presented. Author

N65-20662# Royal Aircraft Establishment, Farnborough (England).
SOME PHYSICAL PROPERTIES OF TERPHENYL RESIN BONDED LAMINATES
B. Nixon London, Min. of Aviation, Dec. 1963 33 p refs
(RAE-TN-CPM-47)

The production of heat-resistant thermosetting resins based on terphenyl and paraxylylene dichloride in various ratios is described. The strength of the laminates made from these resins is shown not to differ greatly and it is concluded that the cross-linking density remains the same for the three ratios investigated. The resistance of asbestos laminates to gamma radiation and strong alkali is investigated, together with some preliminary strength tests on glass-reinforced laminates. Infrared spectrophotometry shows that the methylene groups within both terphenyl and polybenzyl resins are oxidized during aging at elevated temperatures. Author

N65-20744# Royal Aircraft Establishment, Farnborough (England).
INITIAL EVALUATION OF ASBESTOS LAMINATES BONDED WITH POLYBENZYL RESIN
B. J. C. Moore London, Min. of Aviation, Dec. 1963 24 p refs
(RAE-TN-CPM-46)

The preparation of a thermosetting resin from benzyl chloride and *para*dichloroxylylene is described. The flexural and tensile strengths and modulus of elasticity of asbestos laminates are examined on aging at elevated temperatures and a comparison is made with conventional phenolic bonded materials. Variation of the resin preparation to give different crosslink densities is also investigated. It was found that the polybenzyl laminates had superior retention of mechanical properties after exposure to elevated temperatures and after immersion in alkali solutions. Author

N65-20751*# National Beryllia Corp., Haskell, N. J.
RESEARCH ON LOW DENSITY THERMAL INSULATION MATERIALS FOR USE ABOVE 3000°F Fourth Quarterly Status Report, Oct. 1–Dec. 31, 1964
Karsten H. Styhr [1964] 16 p refs
(Contract NASw-884)
(NASA-CR-57727) CFSTI: HC $1.00/MF $0.50

Experiments using ZrO_2 polycrystalline fibers as a structural reinforcement for ZrO_2 foams demonstrated the feasibility of such a concept, and indicate that substantial improvements may be shown in foam strength. Preliminary data on Mo-containing ZrO_2 foams show considerable improvement in thermal insulation performance when compared with plain calcia stabilized ZrO_2 foams of similar density. Author

N65-20940# Defence Research Board, Ottawa (Ontario). Directorate of Scientific Information Services
A METHOD FOR MEASURING POLYMER DECOMPOSITION TEMPERATURES
O. Ya. Fedotova and S. A. Zakoshchikov Mar. 1965 4 p refs
Transl. into ENGLISH from Plasticheskie Massy (Moscow), no. 5, 1960 p 64–65
(T-420-R)

The polymer sample to be tested is placed in a tube connected to a mercury manometer, and heated in a medium with a 60° C melting point. Bath temperature and pressure measurements are plotted against time, with temperature varying linearly (or nearly so). The decomposition point is determined by a sharp increase in pressure accompanied by an abrupt change in the trend of the curve. Decomposition temperature is extrapolated from the temperature curve. Results are given for five samples tested. E.P.V.

N65-21007# Hughes Aircraft Co., Culver City, Calif. Electronic Properties Information Center
ELECTRON MOBILITY IN ALIPHATIC HYDROCARBONS AS RELATED TO ORGANIC INSULATION BREAKDOWN
John T. Milek Feb. 1965 108 p refs
(Contract AF 33(615)-2460)
(EPIC-S-5; AD-609825)

A literature search was made to obtain information on the electron mobility in aliphatic hydrocarbons as related to organic insulation breakdown. Basic terminology and information on electron mobility and electric breakdown are included as well as a discussion of selected important literature references. A brief discussion or annotation of mobility and electric breakdown references as well as other related or pertinent data is given for a wide range of aliphatic hydrocarbon materials in the gaseous, liquid, and solid states. Finally, a bibliography on dielectric, gaseous, liquid, and solid aliphatic materials breakdown is appended. Author

N65-21026# Naval Ordnance Lab., White Oak, Md. Chemistry Research Dept.
HIGH TEMPERATURE RESISTANT MATERIALS FOR MISSILE PROPULSION SYSTEMS Summary Report, 30 Jun. 1963–30 Jun. 1964
F. J. Koubek, B. T. Hartmann, and D. M. Ceum Feb. 1965 67 p refs
(NOLTR-64-207; AD-612504)

A method was devised to compute the thickness of heat shield needed for given conditions and variations in critical parameters were studied. When a constant value for effective thermal diffusivity (alpha) of a phenolic–nylon material was used in place of a variable experimental alpha, the required

thickness of ablator changed by 5% or less. However, when a constant value for heat flux was substituted for variable heat flux, the required thickness changed by as much as 40%. Environmental studies were made on typical organic ablators in the arc image furnace. Most ablators were more efficient at high heat fluxes than low, more efficient in argon than air, and more efficient without than with shear forces acting on them. An alpha-rod automatic feed device operated satisfactorily in experiments on a number of ablators in the oxyacetylene burner. Analog system for reducing alpha-rod data had an average error of ±5%. Phenolic–polyamide resins performed best in solid rocket testing of asbestos laminates. Author

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N65-20143# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS FROM ZHURNAL VYCHISLITEL'NOY MATEMATIKI I MATEMATICHESKOY FIZIKI (JOURNAL OF COMPUTER MATHEMATICS AND MATHEMATICAL PHYSICS), VOL. 4, NO. 6, NOVEMBER–DECEMBER, 1964
24 Mar. 1965 64 p refs Transl. into ENGLISH of 5 articles from Zh. Vychislitel'noi Mat. i Mat. Fiz. (Moscow), v. 4, no. 6, Nov.–Dec. 1964 p 1045–1064, 1112–1117, 1131–1142
(JPRS-29268; TT-65-30579) CFSTI: $3.00

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3. ON LOCATION OF COMMANDS FOLLOWING A COMMAND WITH RANDOM EXECUTION TIME WITH OPTIMAL PROGRAMMING A. I. Serebryanyy p 41–46 ref (See N65-20146 10-08)

4. THE PROBLEM OF OPTIMIZATION IN STOCHASTIC MODELS L. S. Gurin p 47–52 ref

5. ON ONE METHOD FOR SOLVING TRANSPORTATION NETWORK PROBLEMS V. A. Gorelik and M. S. Shtil'man p 53–61 (See N65-20147 10-19)

N65-20144 Joint Publications Research Service, Washington, D. C.
APPROXIMATE SOLUTION OF CERTAIN OPTIMAL CONTROL PROBLEMS
R. D. Fedorenko *In its* Transl. from Zh. Vychislitel'noy Mat. i Mat. Fiz. (J. of Computer Math. and Mathematical Phys.), Vol. 4, No. 6, Nov.–Dec., 1964 24 Mar. 1965 p 1–30 refs (See N65-20143 10-19) CFSTI: $3.00

A description of a numerical method and illustration of its efficiency by application to several practical problems are presented. A problem with a general differential operator is considered. Linear programing concepts were used in order to solve the problem without changing its nonclassical character. The vertical flight of a meteorological rocket probe was selected as a test because a solution by methods of classical variational calculus was known. Results of the numerical solution of this problem are tabulated. The problem with two control functions, the motion of a body of variable mass in the (x, y) plane, is also discussed. E.E.B.

N65-20145 Joint Publications Research Service, Washington, D. C.
ON NUMERICAL SOLUTION OF PROBLEMS ON OPTIMAL PROCESSES WITH DISTRIBUTED PARAMETERS
M. P. Leonchuk *In its* Transl. from Zh. Vychislitel'noy Mat. i Mat. Fiz. (J. of Computer Math. and Mathematical Phys.), Vol. 4, No. 6, Nov.–Dec., 1964 24 Mar. 1965 p 31–40 refs (See N65-20143 10-19) CFSTI: $3.00

Numerical solution of problems on controlled processes with distributed parameters is considered. These problems are associated with optimal control selection. The numerical method discussed was based on approximation of partial differential equations by ordinary differential equations—the line method or the method of integral relations—and on numerical problems associated with ordinary differential equations by means of Pontryagin's principle of the maximum. Conditions for existence and uniqueness of an optimal control of thermal processes were studied, and a numerical solution based on successive location of extrema of some known function of n variables was proposed. E.E.B.

N65-20147 Joint Publications Research Service, Washington, D. C.
ON ONE METHOD FOR SOLVING TRANSPORTATION NETWORK PROBLEMS
V. A. Gorelik and M. S. Shtil'man *In its* Transl. from Zh. Vychislitel'noy Mat. i Mat. Fiz. (J. of Computer Math. and Mathematical Phys.), Vol. 4, No. 6, Nov.–Dec., 1964 24 Mar. 1965 p 53–61 (See N65-20143 10-19) CFSTI: $3.00

A mathematical statement is discussed for the distribution problem. A transport network with n nodes is considered. Suppliers are located at r nodes, users at s nodes, and the remaining $n - (r + s)$ nodes are related to the transportation system. The problem then reduces to the determination of an optimal scheme providing distribution of goods in the network in such a manner that

$$Z = \sum_{i,j=N} c_{ij} x_{ij}$$

is minimal. Here x_{ij} is the quantity of goods transferred from the i-th node to the j-th node, and N is the number of pairs (i, j) corresponding to elements in an optimal plan. Also a machine algorithm compiled for computer solution of this problem is described. E.E.B.

N65-20237# Illinois Univ., Urbana. Coordinated Science Lab.
GENERATION OF DIRECTED TREES, 2-TREES AND PATHS WITHOUT DUPLICATION
A. Paul, Jr. Jan. 1965 48 p refs
(Contract DA-28-043-AMC-00073(E))
(R-241; AD-610149)

The increasing applications of graph theory to the solution of problems in many fields make it desirable to have available complete knowledge of the properties of these graphs. Since many problems in electrical networks, switching circuits, and communication nets can be formulated in terms of directed graphs, it is appropriate to study their properties. In this paper, procedures are developed for generating the directed trees, 2-trees and paths of a directed graph. Unlike other methods for generating these subgraphs, the procedures developed here avoid generating duplicate elements, thus eliminating the necessity of repeated search to select a complete set of

elements. Proofs are given to verify that all elements of the set of directed trees, 2-trees or paths are generated and that no duplicate elements occur. Examples are given to illustrate the procedures in detail. The procedures are amenable to digital computer application. Author

N65-20304# Argonne National Lab., Ill. Reactor Physics Div.
AN ITERATIVE UNFOLDING METHOD FOR RESPONSE MATRICES
Raymond Gold Dec. 1964 42 p refs
(Contract W-31-109-ENG-38)
(ANL-6984) CFSTI: $2.00

The problem of unfolding the output data of a detection system is reviewed. Physical implications of the matrix representation of a detection system are discussed. An iterative method of solution is presented; its properties are investigated, and proof of convergence to the exact solution is given for two-dimensional, triangular, and positive definite-type response matrices. The unfolding characteristics of the method are examined by applying the iterative process to the results of a neutron detection system. Limitations of the iterative method are discussed. Author

N65-20307# Aberdeen Proving Ground, Md., Ballistic Research Labs.
THE MATHEMATICAL ANALYSIS OF A SIMPLE DUEL
Arthur D. Groves Aug. 1964 26 p ref
(BRL-1261; AD-609195)

The principles and techniques of simple Markov processes are used to analyze a simple duel to determine the limiting state probabilities (i.e., the probabilities of occurrence of the various possible outcomes of the duel). The duel is one in which A fires at B at a rate of r_A shots per minute starting at time $t = 0$ and with a single shot kill probability of P_A, and B fires at A at a rate of r_B shots per minute starting at time $t = \delta$ and with a single shot kill probability of P_B, and this exchange of fire continues until either A or B, or both are killed. Author

N65-20346# California Univ., Los Angeles. Western Management Science Inst.
CAPACITY OF QUEUING NETWORKS
Richard V. Evans Jan. 1965 12 p refs *Its* Working Paper No. 62
(Contract Nonr-233(73))
(RR-92; AD-610135)

The equivalence of two concepts of the capacity is developed. Capacity is the limiting load ratio (arrival rate measured in service rate units) for stable behavior. It is also defined as the expected output rate of the system operated under a saturation load. Additional information is obtained about the behavior of a specific example previously considered. Author

N65-20373# George Washington Univ., Washington, D. C.
SUMMATION BY PARTS, ABEL'S IDENTITY, AND MATHEMATICAL EXPECTATION
W. H. Marlow 13 Jan. 1965 14 p refs
(Contract Nonr-761)
(T-179; AD-610170)

This report starts with an introduction to the summation calculus through consideration of sums and differences as inverses. Several relations are derived for use in transforming sums, including sums of infinitely many terms. Special attention is paid to problems of convergence for expectations relative to discrete probability distributions. Author

N65-20439# Johns Hopkins Univ., Baltimore, Md.
LINEAR RELATIONSHIPS BETWEEN VARIABLES AFFECTED BY ERRORS
F. D. Carlson, E. Sobel, and G. S. Watson [1964] 21 p refs
(Contract Nonr-4010(09); Grant NIH-RG-3723)
(AD-610159)

A method of solving linear regression problems where all variables are subject to error in measurement is presented. In the classical linear regression problem, a Y-value, which is subject to experimental error, is expressed as a linear function of X-values which are known without error; the problem posed in this paper is a variation of this where the X-values are subject to error. A solution is given which involves choosing additional Z-values such that each X-value can be regarded as a linear function of the Z-values; the Z-values, too, are known with error. If the Z-errors are uncorrelated with the Y- and X-errors, the regression problem can be solved by the method of canonical correlation. A commercially available computer program is used for the correlation calculations. A biochemistry problem is worked as an example. J.M.D.

N65-20441# Andrews Univ., Berrien Springs, Mich. Dept. of Mathematics
OPERATORS IN ENERGY SPACE
E. J. Specht and H. T. Jones Dec. 1964 44 p refs
(Contract Nonr-3911(00))
(AD-610105)

The Neumann–Poincaré integral equation arises in connection with the Dirichlet and Neumann problems of potential theory and in connection with conformal mapping. Warschawski proved the compactness of the integral operator involved under what seem to be natural smoothness conditions on the boundary curve, for the case where the boundary is a single contour. Because this proof relies heavily upon complex function theory, it does not extend easily to higher dimensions. It is the purpose of this paper to give a proof, for the case of several contours, which will extend readily to higher dimensions. Author

N65-20449# RAND Corp., Santa Monica, Calif.
THE NUMERICAL SOLUTION OF THE CHEMICAL EQUILIBRIUM PROBLEM
R. J. Clasen Jan. 1965 88 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4345-PR; AD-609904)

Methods are described for starting the solution when an initial estimate is not available, and for improving an initial estimate to make it feasible. A first-order method and a second-order method are presented for solving the chemical equilibrium problem in the context of the linear-logarithmic programing problem, and convergence criteria are provided for the majority of problems of this type that are likely to be attempted. Author

N65-20528# New York Univ., N. Y. Courant Inst. of Mathematical Sciences
FREDHOLM OPERATORS AND THE ESSENTIAL SPECTRUM
Martin Schechter Jan. 1965 24 p refs
(Contract DA-31-124-ARO(D)-204)
(IMM-NYU-335; AROD-247-64; AD-611812)

Fredholm operators are defined and their basic properties are proved. The essential spectrum of an arbitrary closed operator is considered, and its invariance under several kinds of perturbation is proved. Author

N65-20547# Stanford Univ., Calif. Dept. of Statistics
MARKOVIAN SEQUENTIAL REPLACEMENT PROCESSES
Howard M. Taylor 3 Feb. 1965 40 p refs
(Contract Nonr-225(53); NSF GP-1625)
(TR-78; AD-611544)

Replacement processes whose state space is a subset of a finite dimensional Euclidean space are discussed. The rule which minimizes the total expected discounted cost is known and is used to show the existence of a nonrandomized stationary decision rule which minimizes the average cost per unit time. A relationship between the optimal rules under both criteria is given wherein the optimal average cost rule is the limit, in some sense, of a sequence of discounted cost rules which yields a functional equation characterizing the optimal average cost rule. Finally, some examples employing the theory are given. Author

N65-20558# Stanford Univ., Calif. Computer Science Div.
ON APPROXIMATE CALCULATIONS OF THE EIGENVALUES AND EIGENFUNCTIONS OF BOUNDARY VALUE PROBLEMS IN PARTIAL DIFFERENTIAL EQUATIONS
V. A. Efimenko 24 Nov. 1964 22 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Mat. (Moscow), 1938 p 613–623
(Contract Nonr-225(37))
(CS14; AD-611095)

In this work it is proved that the eigenvalues and eigenfuctions of the boundary value problem

$$\frac{\delta(p\,\frac{\delta\phi}{\delta x})}{\delta x} + \frac{\delta(q\,\frac{\delta\phi}{\delta y})}{\delta y} - r\phi + \lambda s\phi = 0$$

with $\phi = 0$ on the contour Γ, can be approximated to arbitrary accuracy by the eigenvalues and eigenfunctions of the associated difference equation with boundary condition $\phi^{(h)} = 0$ on the contour Γ_h approximating Γ. Author

N65-20590# Johns Hopkins Univ., Baltimore, Md. Dept. of Statistics
ON THE BEHAVIOUR OF THE CHARACTERISTIC FUNCTION OF A PROBABILITY DISTRIBUTION IN THE NEIGHBOURHOOD OF THE ORIGIN, PART I
E. J. G. Pitman Jun. 1964 20 p refs
(Contract Nonr-4010(09))
(AD-610157)

Five theorems on relationships between distribution functions, F(x), and characteristics functions, $\phi(t)$, are proved. The theorems pertain to the tails of the distribution, F(x) and $1 - F(-x)$ where x is distant from the origin, and to $\phi(t)$ in the neighborhood of $t = 0$. Interest in this topic is motivated by the fact that all limit theorems on sums of random variables depend on the behavior of the characteristic function close to the origin, $t = 0$. J.M.D.

N65-20592# Carnegie Inst. of Tech., Pittsburgh, Pa. Graduate School of Industrial Administration
COINCIDENCE COUNTING AND RENEWAL RUNS
D. P. Gaver, Jr. Jun. 1964 28 p refs
(Contract Nonr-27)
(ONR-RM-124; AD-610192)

Semi-Markov processes are used to evaluate the distribution of time in the interaction between a photon and a chemical particle until it becomes a developable speck for photographic detection. The time from the lowest energy state, up to and including the permanent latent image speck, is studied by coincidence counting by replacing the assumption of Poisson-arriving photons with that of a general renewal process. The presented model may be modified to describe energy transitions down by only one step instead of all the way to zero. G.G.

N65-20598# Johns Hopkins Univ., Baltimore, Md. Dept. of Statistics
ESTIMATION IN FINITE POPULATIONS
Geoffrey S. Watson [1963] 14 p refs
(Contract Nonr-4010(09))
(AD-610156)

The problem of choosing finite-sample estimators of parameters in finite populations is considered. The sample mean, calculated for a randomly drawn sample, is shown to be the minimum-variance estimate of the population mean. The concept of random sampling is reviewed from the Bayesian point of view; the point is made that random sampling is a reasonable procedure only when the nature of the population is sufficiently unknown that no sample could be recognized as being representative of the population. J.M.D.

N65-20697# RAND Corp., Santa Monica, Calif.
NUMERICAL INTEGRATION OF A DIFFERENTIAL-DIFFERENCE EQUATION WITH A DECREASING TIME-LAG
R. E. Bellman, J. D. Buell, and R. E. Kalaba Dec. 1964 16 p refs
(Grant PHS-GM-09608-03)
(RM-4375-NIH; AD-609835)

Systems in which variable timelags are present are of common occurrence in biology. Variable flow rates are a common cause of these variable lags. At present no extensive body of knowledge exists concerning the effects which these variable lags can cause. It is shown how to reduce some differential-difference equations to ordinary differential equations, which can then be studied numerically with ease. Subsequent reports will deal with situations in which multiple lags and lags dependent on the solution itself are present. Author

N65-20765# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ABOUT A METHOD OF NUMERICAL SOLUTION OF NONLINEAR SYSTEMS
A. Krylov 13 Jan. 1965 6 p refs Transl. into ENGLISH from Vopr. Vychislitel'noy Mat. i Vychislitel'noy Tekhn. (USSR), 1963 p 82–84
(FTD-TT-64-612/1; AD-610351)

An iterative method is presented for solution of systems of simultaneous, nonlinear equations. The method is based on the fact that under certain well-defined conditions the nonlinear system can be approximated by a linear system. For instance, solution of a nonlinear system of two equations, $G(x_1, x_2) = 0$ and $H(x_1, x_2) = 0$, proceeds by defining the function $G^2(x_1, x_2) + H^2(x_1, x_2)$, which under the linear-approximation assumptions has a decomposition of the form $f(x_1, x_2) + s(x_1, x_2)$; the decomposition is then minimized sequentially to yield the solution. J.M.D.

N65-20787# Michigan State Univ., Ann Arbor. Dept. of Statistics
ON A PARTIAL DIFFERENTIAL EQUATION OF EPIDEMIC THEORY. II—THE MODEL WITH IMMIGRATION

J. Gani 5 Jan. 1965 14 p refs
(Contract Nonr-2587(05))
(RM-124; JG-4; AD-609960)

A stochastic model for epidemics is presented which allows for immigration of new susceptible individuals during the course of the epidemic. The problem was to find the explicit probability of having a specific number of uninfected susceptibles and infectives, and a specific number of immigrated susceptibles, at a given time. The probability was described in such a way that it could be related to a differential equation for the epidemic process, which implied a definite form for the probability generating function. A method is given for solution of the differential equations to get the generating function. J.M.D.

N65-20788# RAND Corp., Santa Monica, Calif.
ON MARKOV CHAINS WITH THE STRONG RATIO LIMIT PROPERTY
J. H. Folkman and S. C. Port Jan. 1965 17 p refs
(Contract AF 49(638)-700)
(RM-4355-PR; AD-610315)

The probability that a particle moving according to a recurrent random walk is in a given finite set at some time long after the starting time is proportional to the number of points in the set. This property is not true for all random motions, and it is a matter of interest in probability theory to know for what systems an analogous result is true. Some necessary and sufficient conditions are presented for a Markov chain under which there is an analogous result. E.E.B.

N65-20789# Martin Co., Baltimore, Md. Center for Control Theory
NOTES ON THE THEORY OF FINITE MACHINES
J. J. Florentin Aug. 1964 80 p refs
(Contracts NASw-845; AF 49(638)-1206)
(TR-64-15; AFOSR-64-1787; AD-609991)

A machine is defined by its input–output behavior and this was related to a memory state model of the working of the machine. Further, a normal form which could be manipulated algebraically was produced. This normal form eliminates differences in machine behavior and makes accessible all the accumulated results of group and semigroup theory. Functions are used on free semigroups, i.e., machines to prove facts about finite semigroups. An immediate corollary of a more general theorem, which is proved in the article, finds application as the basis for a prime decomposition theorem for finite state sequential machines. Further, by theorem application, together with the powerful solvability criteria of Feit and Thompson, and of Burnside, a corollary is found to answer the question—what machines can be constructed by series–parallel from counters, delays and units? E.E.B.

N65-20795*# Catholic Univ. of America, Washington, D. C.
CONFORMAL MAPPING OF A CLASS OF DOUBLY CONNECTED REGIONS Technical Report No. 8
Patricio A. Laura Jan. 1965 75 p refs
(Grant NsG-125-61)
(NASA-CR-57707) CFSTI: HC $3.00/MF $0.75

It is shown in the present investigation that the system of two integral equations obtained by Kantorovitch and Muratov for the conformal mapping of an arbitrary, finite, doubly connected region onto a circular annulus simplifies considerably when the configuration has one or more axes of symmetry and one of the boundaries is a circle. Once the correspondence between boundary points is established, the function which maps the annulus B_ζ in the ζ-plane onto the given domain B_z in the z-plane is obtained by a procedure of successive approximations. The method is illustrated in several cases where the web fraction is close to one. Author

N65-20847# Argonne National Lab., Ill. Applied Mathematics Div.
SINGULAR INTEGRALS AND SINGULAR EQUATIONS WITH A CAUCHY KERNEL AND THE METHOD OF SYMMETRIC PAIRING
Erwin H. Bareiss and Charles P. Neuman (Harvard Univ.) Jan. 1965 46 p refs
(Contract W-31-109-ENG-38)
(ANL-6988) CFSTI: $2.00

The method of symmetric pairing, combined with midpoint integration, is introduced for the numerical evaluation of Hilbert transforms (and the Kramers–Krönig relations) and singular integral equations with a Cauchy kernel. The method, for use on high-speed computers, is simple, reliable, and inexpensive. Numerical examples are presented. Author

N65-20865# Johns Hopkins Univ., Baltimore, Md. Dept. of Statistics
LOCALLY MOST POWERFUL RANK TESTS FOR THE TWO-SAMPLE PROBLEM WITH CENSORED DATA
Joseph L. Gastwirth Dec. 1964 9 p refs
(Contract Nonr-4010(09))
(AD-610158)

Locally most powerful ranks tests (LMPRT) are derived for various censored-data problems. The problem is described as follows: two populations of continuous values are represented by their unknown distribution functions, F(x) and G(x); samples are drawn from the two populations and a single ranking is determined for their combined values to test the hypothesis that the distributions are the same. If part of either sample is unobservable (or lost), the sample is censored, and thus the ranking is only partially known. A method is demonstrated for obtaining the weighting function, to be applied to the censored ranking, which is the LMPRT for specified problems. These functions are shown for the hypothesis-testing problems that the Wilcoxon, Normal Scores, and Savage ranks tests are designed to solve. J.M.D.

N65-20880*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
A SPECIAL FORM OF A GENERALIZED INVERSE OF AN ARBITRARY COMPLEX MATRIX
Henry P. Decell, Jr. Washington, NASA, Apr. 1965 16 p refs
(NASA-TN-D-2748) CFSTI: HC $1.00/MF $0.50

The primary concern of this paper is to investigate the problem of inversion of singular or nonsquare matrices. In this connection, a new algorithm for computing the generalized inverse of an arbitrary complex matrix is given. For a nonsingular matrix the algorithm gives the ordinary inverse of the matrix. A definition-theorem exposition of the known results in the literature, and a new explicit form, together with an algorithm for computing the new explicit form are given. An application to least squares approximation is given that can easily be realized in trajectory analysis problems. Finally, a computer program for computing the generalized inverse of a matrix is given utilizing the algorithm mentioned. Author

N65-20929# Land-Air, Inc., Point Mugu, Calif. Paradyn Div.
ON THE TRANSFORMATION OF PROBABILITY ELLIPSES INTO CIRCLES FOR IMPACT PROBLEMS

Eberhard H. Baur 2 Jul. 1962 35 p
(Contract N-123(61756)19425A/PMR)
(Rept.-34; AD-281750)

The transformation of P% probability ellipses into P% probability circles is numerically calculated. It follows a discussion about the sense of the transformation, separating confidence areas from actual distributions of impact points. After the P% confidence ellipse for the mean M of a normal distribution is transformed into the principle axes, a circle with radius r, and the center point (0,0) is constructed which covers M with P%. For P(%) = 50, 75, 90, 95, 99 and given σ_x, σ_y of the principle axes, r is tabulated to an accuracy less than 0.4% of the semiaxes. The P% circle cuts an area A and adds an area B to the equivalent P% ellipse. The ratio q for the above given P values, and ratios $\sigma_y:\sigma_x$. The q indicates the loss of the denser area A, which is important in impact point problems with a known normal distribution. On the average, objects of same size have a greater chance of being an impact point in A than in B. Author

N65-21081# European Atomic Energy Community, Brussels (Belgium).
ON VARIETY SEPARABILITY OF SUBSETS OF A MONOID, WITH APPLICATIONS TO FINITE AUTOMATA
L. A. M. Verbeek Dec. 1964 16 p refs Presented at Intern. Summer School of Phys., Course on Automata Theory, Ravello, Italy
(EUR-2186.e) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 40 Belg. Fr.

Let $R = [R_i : i \in I]$, where I is an index set, be a collection of disjoint subsets of a monoid F, and Let V be a variety of monoids. R is said to be V-separable if there exists a homomorphism γ of F on a monoid $M \in V$ such that M contains a collection of disjoint subsets $P = [P_i : i \in I]$ for which $\gamma^{-1} P_i \geq R_i$ for each $i \in I$. Necessary and sufficient conditions are derived for variety separability. In case R is a collection of regular events, these conditions yield an effective procedure for deciding whether R is separable by a given variety of monoids. Author

N65-21127# George Washington Univ., Washington, D. C.
A DEMAND DISTRIBUTION MODEL
Fred D. Rigby 14 Dec. 1964 21 p
(Contract Nonr-761)
(T-175; AD-610169)

A particular repair policy is employed as rationale for the derivation of a time-dependent stochastic process which yields a family of demand distributions appropriate to situations in which demand events have multiple outcomes. Elementary properties of these distributions are derived. Under plausible specialization of assumptions the family is found to include the Poisson distribution and a known natural generalization thereof. Author

N65-21136# Sandia Corp., Albuquerque, N. Mex.
DISPOSITION ANALYSIS
L. W. Rook Nov. 1964 14 p refs
(SC-R-64-1359) CFSTI: $1.00

A technique is described by which the latent structure model of multivariate analysis formulated by Lazarsfeld may be applied with only moderate computational effort. The technique, termed disposition analysis, is based upon defining a functional relationship between variables and patterns of variables. Both continuous and discontinuous variables may be treated separately or intermixed. Author

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N65-20382# Weather Wing (2nd), APO 332, New York.
TECHNICAL BULLETIN
Jul. 1964 67 p refs
(AD-452918)

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4. THE SELECTION AND USE OF PREDICTORS IN AN OBJECTIVE FORECAST STUDY A. E. Stockel p 27-35 (See N65-20386 10-20)
5. UPPER-AIR FLOW PATTERN AND THE AVIANO WEATHER S. Pilipowskyj p 36-61 refs (See N65-20387 10-20)
6. AN INVESTIGATION OF THE APPLICABILITY OF ATMOSPHERIC ELECTRIC MEASUREMENTS TO FOG PREDICTION D. G. Rogers p 62-68 refs (See N65-20388 10-20)

N65-20383 Weather Wing (2nd), APO 332, New York. Field Operations Div.
A REVIEW OF EXTRAPOLATION AS A SHORT-RANGE FORECASTING TOOL
A. E. Stockel *In its* Tech. Bull. Jul. 1964 p 1-6 ref (See N65-20382 10-20)

Linear extrapolation is used when a weather pattern of uniform shape and size is moving at a uniform rate. This pattern is forecasted to continue moving at this rate. Nonlinear extrapolation is used when a weather area of changing shape and size is moving at a nonuniform rate. Extrapolation of isochrones is used on an area chart that has been analyzed for lines of simultaneous occurrence of a specific event. Extrapolation through the use of the distance–time diagram is used for particular events at specified times. Detailed procedures for each event are presented. E.E.B.

N65-20384 Weather Wing (2nd), APO 332, New York.
COMPUTATION OF FORECAST WIND FACTORS
In its Tech. Bull. Jul. 1964 p 7-13 (See N65-20382 10-20)

Five methods of computing forecast wind factors (FWF) were evaluated to determine (1) the most practical method of computing FWF's; (2) the time required to compute an FWF; and (3) the feasibility of computing FWF's in support of the Eastern Atlantic Airlift Command Post (EAACP). The five methods are summarized. During the test the flow patterns ranged from a high index situation to an almost complete reversal of normal flow at 700 and 600 millibars along the entire route. The verification of the FWF obtained by the five methods and the time required to compute the FWF by each method were of primary interest. Results of the test are included. E.E.B.

N65-20385 Weather Wing (2nd), APO 332, New York. Climatology Div.
THE USE OF SOIL MOISTURE COMPUTATIONS IN PLANNING
Donald C. Winner *In its* Tech. Bull. Jul. 1964 p 14–26 refs (See N65-20382 10-20)

The results of several soil moisture bookkeeping calculations are presented and interpreted in terms of the ability of heavy equipment to move cross-country. Two practical examples of the use of soil moisture computations are included. Author

N65-20386 Weather Wing (2nd), APO 332, New York. Field Operations Div.
THE SELECTION AND USE OF PREDICTORS IN AN OBJECTIVE FORECAST STUDY
A. E. Stockel *In its* Tech. Bull. Jul. 1964 p 27–35 (See N65-20382 10-20)

The systematic selection and combination of predictors increase the chance of success for the forecast study. The use of multiple predictors on a single scattergram could indicate a graphical solution to a problem too difficult for a forecaster to integrate. Therefore, this method could be a basic, rudimentary approach to computer forecasting. The selection of predictors; the pilot study which restricts the study to a specific event associated with a definite synoptic situation; and the use of predictors are discussed. The most important phase in the pilot study is the selection of the parameters to be used as predictors. Guidance for this selection is included. E.E.B.

N65-20387 Weather Wing (2nd), APO 332, New York.
UPPER-AIR FLOW PATTERN AND THE AVIANO WEATHER
Serhij Pilipowskyj *In its* Tech. Bull. Jul. 1964 p 36–61 refs (See N65-20382 10-20)

This paper presents in a compact form the relationships between the large-scale weather pattern over Europe and the associated weather at Aviano AB, Italy. The data presented can be used as a tool for training new forecasters at Aviano as well as to provide a useful reference file for all forecasters. The paper also gives forecasters the capability to forecast weather for Aviano AB with a very limited amount of data, possibly using only the local winds aloft and surface observations. Author

N65-20388 Weather Wing (2nd), APO 332, New York.
AN INVESTIGATION OF THE APPLICABILITY OF ATMOSPHERIC ELECTRIC MEASUREMENTS TO FOG PREDICTION
Dale G. Rogers *In its* Tech. Bull. Jul. 1964 p 62–68 refs (See N65-20382 10-20)

A literature search undertaken to determine what had been done in the field of atmospheric electricity as related to fog forecasting and fog dissipation is summarized. The observations of Navy research personnel seem extensive enough to dispel any doubt that, at least for maritime locations, atmospheric electric measurements can be used effectively in short-range prediction of fog variability. Further, conductivity and aerosol concentration measurements are significant and can be used by a skilled and informed observer. However, they are not suitable for inclusion in a fog warning display in which judgment of a skilled interpreter is not used. E.E.B.

N65-20612# American Meteorological Society, Boston, Mass.
VERIFICATION OF FORECASTS OF MONTHLY PRECIPITATION ANOMALIES BY THE VITEL'S METHOD [REZUL'TATY PROVERKI PROGNOZOV MESIACHNYKH ANOMALII OSADKOV PO METODU L. A. VITEL'SA]
N. L. Spitsyna Bedford, Mass., AFCRL, May 1964 23 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 148, 1963 p 77–89
(Contract AF 19(628)-3880)
(T-R-440; AD-610113)

Data are given on the reliability of forecasting monthly precipitation anomalies by the L. A. Vitel method. Analysis of data for a 7-year period has shown that the method has better than random reliability. Months and regions are cited for which the best results were obtained. Author

N65-20727# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CLIMATE OF THE USSR, ISSUE 4, WESTERN SIBERIA
V. V. Orlova 29 Dec. 1964 395 p refs Transl. into ENGLISH of the book "Klimat SSSR, Vypusk 4, Zapadnaya Sibir'" Leningrad, Gidrometeorol. Izd., 1962 p 1–360
(FTD-MT-63-337; AD-609914)

This monograph contains descriptions of the main climate-forming factors, and the general characteristics of the Western Siberia climate by season. Also discussed are its separate elements—such as thermal regime, moisture conditions, wind region, and atmospheric phenomena—in connection with the physicogeographic peculiarities of the regions. The characteristics of the climate for the tundra and forest-tundra zones, the forest-steppe and steppe zones, as well as for the forest zone are presented. The list of observation stations, tables of climatic data for the different regions, and weather maps from the Western Siberian area are also included. G.G.

N65-20884*# National Aeronautics and Space Administration, Washington, D. C.
REASONS FOR THE LACK OF CORRELATION BETWEEN ATMOSPHERIC DISTURBANCES AND WEATHER CONDITIONS [O PRICHINAKH NESOOTVETSTVIYA ATMOSFERIKOV S USLOVIYAMI POGODY]
V. A. Solov'yev Apr. 1965 6 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 157, 1964 p 73–75
(NASA-TT-F-332) CFSTI: HC $1.00/MF $0.50

Data from Soviet and foreign scientists on the relation of atmospheric storms and weather conditions are considered. Causes of the lack of correlation of cathode detection and meteorological conditions are studied, and are evaluated in respect to materials obtained in the U.S.S.R. Author

N65-20893# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
ATHENA FLIGHT NUMBER 012 VEHICLE D-008 (15 FEBRUARY 1965 Meteorological Data Report
Len E. Carter and John M. Sharpe Mar. 1965 53 p refs
(ERDA-283; AD-458904)

Meteorological data gathered for the launching of Athena Flight Number 012, Vehicle D-008, are presented for ballistic studies. The data are presented in tabular form. Author

N65-20909# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
AEROBEE AE 3.153 (S/N AF 150-3), METEOROLOGICAL REPORT
Marjorie Mc Lardie Hoidale Mar. 1965 41 p refs
(ERDA-281; AD-459081)

Meteorological data gathered for the launching of Aerobee AE 3.153 (S/N AF 150-3) are presented for ballistic studies and appear along with calculated ballistic data. Author

N65-20910# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
AEROBEE AE 3.517 (S/N AF 151) (3 MARCH 1965) Meteorological Data Report
Marjorie Mc Lardie Hoidale Mar. 1965 39 p refs
(ERDA-291; AD-459361)

Meteorological data gathered for the launching of Aerobee AE 3.517 (S/N AF 151) are presented for ballistic studies, along with calculated ballistic data. Author

N65-20911# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
AEROBEE AE 3.518 (S/N AF 115) (4 MARCH 1965) Meteorological Data Report
Marjorie Mc Lardie Hoidale Mar. 1965 45 p refs
(ERDA-292; AD-459079)

Meteorological data gathered for the launching of Aerobee AE 3.518 (S/N AF 115) are presented for ballistic studies, along with calculated ballistic data. Author

N65-20912# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
AEROBEE NASA 4.133 UG (S/N NASA 104) (5 MARCH 1965) Meteorological Data Report
Marjorie Mc Lardie Hoidale Mar. 1965 43 p refs
(ERDA-293; AD-459080)

Meteorological data gathered for the launching of Aerobee NASA 4.133 UG (S/N NASA 104) are presented for ballistic studies and appear along with calculated ballistic data. Author

N65-21009# American Meteorological Society, Boston, Mass.
THE NATURE OF NOCTILUCENT CLOUDS [PRIRODA SEREBRISTYKH OBLAKOV]
S. P. Dobrovol'skii Bedford, Mass., AFCRL, [1964] 8 p refs Transl. into ENGLISH from Priroda (Moscow), no. 3, 1964 p 87–89
(Contract AF 19(628)-3880)
(T-R-441; AD-608976)

The thesis is presented that most of the water, whose condensation products form noctilucent clouds, is of cosmic origin. The two hypotheses on the nature of noctilucent clouds discussed are the condensation theory and the meteoric theory. The first proposes that noctilucent clouds result from the condensation of water vapor transported by ascending air currents from the troposphere into the upper atmosphere as a result of vertical mixing. The meteoric hypothesis states that noctilucent clouds consist of mineral particles of silicate composition and of extraterrestrial origin. Data from meteorites are used to show that the noctilucent clouds can indeed result from cosmic water. E.E.B.

N65-21019# Massachusetts Inst. of Tech., Cambridge.
REACTIONS OF THE GENERAL CIRCULATION TO SUDDEN SOLAR DISTURBANCE Final Report
H. C. Willett and J. T. Prohaska Apr. 1964 60 p refs
(Contract AF 19(604)-7996)
(AFCRL-65-22; AD-612681)

Indices of solar activity were analyzed for the establishment of criteria by means of which 137 key days of solar disturbance are selected. A 190-point grid of the daily northern hemispheric weather patterns was tabulated from the 5th day preceding to the 15th day following each key day of solar disturbance. Key days were grouped by type of solar disturbance, season and initial state of the general circulation. The key day groups are treated by the superposed epoch procedure, and the epoch sequences tested for statistical significance by a number of statistical techniques. Little evidence is found of any consistent solar influence on the group mean hemispheric weather patterns relative to key days of solar disturbance, but there is moderately significant evidence of some suppression of the variability of these patterns during the first four days and an increase of the variability about the 14th day following the key day of solar disturbance. Author

N65-21034# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
METEOROLOGICAL DATA REPORT: NIKE-APACHE SPEEDBALL II (ROUND NO. 70 SN 26), (5 FEBRUARY 1965)
Stanley F. Kubinski Mar. 1965 38 p
(ERDA-276; AD-458310)

Meteorological data collected for the launching of NIKE-APACHE Speedball II, Round No. 70, SN-26, are presented for future ballistic studies. The meteorological data and resulting ballistic data appear in appendixes. Author

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N65-20645# Royal Aircraft Establishment, Farnborough (England).
PRELIMINARY STUDIES FOR MODELS OF FUTURE NORTH ATLANTIC AIR TRAFFIC CONTROL SYSTEMS WITH PARTICULAR REFERENCE TO SUPERSONIC FLIGHT
P. G. Reich London, Min. of Aviation, Mar. 1961 42 p refs
(RAE-TN-MATH-77)

Two extreme forms of air traffic control are discussed. An attempt is made to characterize future supersonic traffic flow on North Atlantic routes. Separation standards appropriate to fixed track systems are derived. Some simple models are discussed with reference to safety and economic factors. Author

N65-20667# Royal Aircraft Establishment, Farnborough (England).
A THEORY OF SAFE SEPARATION STANDARDS FOR AIR TRAFFIC CONTROL
P. G. Reich Nov. 1964 45 p refs
(RAE-TR-64041)

Expressions for collision risk are given in terms of elementary probabilities and of frequencies with which aircraft pass each other in the three dimensions of space. Techniques are proposed for setting confidence limits to estimates of the probabilities, including those that depend on the occurrence of large, rare flying errors, so that similar confidence may be

placed in estimates of collision risk. The large errors are presented by three alternative mathematical descriptions, so that the decision maker, when considering proposals for separation standards, can compare the effect of alternative key assumptions on the estimated risk of collision. Author

N65-20673# Royal Aircraft Establishment, Farnborough (England).
A FORECAST OF DIURNAL TRAFFIC PATTERNS OF SUPERSONIC TRANSPORT AIRCRAFT ON NORTH ATLANTIC ROUTES
V. W. Attwooll London, Min. of Aviation, Jan. 1964 14 p
(RAE-TN-MATH-107)

Estimates are given of the operating time bands for supersonic aircraft on transatlantic flights, and of the resulting eastbound and westbound flow rates in the N. Atlantic area in 1975. Although the number of flights expected in any particular year is necessarily speculative, the peculiarities of the pattern of supersonic operations are readily seen. Author

N65-20707# Burroughs Corp., Paoli, Pa.
BEACON THREE-MODE STUDY Final Report, Phase I
Sep. 1964 126 p
(Contract FA-64-WA-5116)

This analysis considers the performance on a target when all conditions are at their poorest. The conclusion is that using a leading edge of 7 and a trailing edge of 2, with interlace pattern 32C32C. . . , and window size 11 provides optimum overall system performance. Composite graphs were constructed using the target run-length that gave worst performance for each individual parameter. Obviously, this situation cannot hold. Performance is better for P_S and τ for the short run-length target, and is better for P_D and P_V for long run-length targets. Author

N65-20718# Massachusetts Inst. of Tech., Cambridge. Instrumentation Lab.
APPLICATION OF INERTIAL LOCATOR CONCEPTS TO FAA BASIC FLIGHT INSPECTION, VOLUME I Final Report
Jan. 1965 120 p refs
(Contract FA-65-WA-5139)
(R-483, Vol., I; RD-65-9)

The inertial system may be used to control the aircraft to fly specified paths. The position indication problem was studied with respect to flight inspection of VOR, VORTAC, and TACAN stations, and Instrument Landing Systems (ILS). Design objectives established for the stations require that the aircraft azimuth from the station be measured to within 2 mrad, 1_σ, both in 15-nautical-mile orbits and along radial paths. Error perpendicular to the path may range between two mrad at 15 miles to 50 feet at the station. With respect to ILS, design objectives include the maintenance of 1-mrad, 1_σ, aircraft locating accuracy in azimuth to the outer marker, decreasing linearly to 0.33 mrad at the middle marker, but no smaller than 3.6 ft, 1_σ. In elevation corresponding values are 1 mradian, 1_σ, to outer marker; a linear reduction to 0.5 mrad, 1_σ, at the middle marker; and no smaller than 1Σ. Based on the results, it appears that inspection requirements are achievable with equipment and techniques within the current state-of-the-art, except that a hybrid system must be used in certain cases. Author

N65-20968*# Honeywell, Minneapolis, Minn. Aeronautical Div.
STUDY OF AN ATTITUDE REFERENCE SYSTEM UTILIZING AN ELECTRICALLY SUSPENDED GYRO Final Report, 1 Aug. 1964–31 Mar. 1965
R. E. Dobrzynski, J. K. Olson, and R. C. Amos 31 Mar. 1965 344 p Prepared for JPL
(Contracts NAS7-100; JPL-950915)
(NASA-CR-57783; Rept.-20113-FR-1) CFSTI: HC $7.00/MF $1.75

The feasibility of using miniature electrostatic gyros (MEG) in a spacecraft attitude reference system was investigated by establishing the relationships between major system parameters, and through the preliminary design of a strapped down MEG attitude reference system for a landing capsule. The following five conclusions were reached: (1) Parameter studies showed that the selected configurations can be built for a system pointing accuracy in the range 0.04° to 0.07°. (2) The system size, weight, power, and reliability were increased by less than 10% through change to an output of attitude error and body rate. (3) Caging capability beyond the current gyro design would not influence the system configuration. (4) The performance requirements for the landing system can be satisfied by a system containing a single electrostatic gyro. (5) The ARS rate outputs were limited by noise on the gyro readout. A digital computer for selected ARS concepts was evaluated, and the necessity to supply each gyro pickoff with its own set of electronics is discussed. G.G.

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N65-20126# Atomic Energy Commission, Germantown, Md. Div. of Isotope Development
CONFERENCE ON ISOTOPIC POWER DEVELOPMENT
[1964] 278 p refs Conf. held at Germantown, Md., 18–19 May 1964
(TID-7698(Pt.I)) CFSTI: $6.00

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1. THE FISSION PRODUCTS C. A. Rohrmann (Hanford Atomic Prod. Operation, Richland, Wash.) p 1–16 refs (See N65-20127 10-22)

2. ISOTOPIC POWER DATA SHEETS S. J. Rimshaw (Oak Ridge Natl. Lab., Tenn.) p 17–32 (See N65-20128 10-24)

3. HANDBOOK OF SHIELDING REQUIREMENTS AND RADIATION CHARACTERISTICS OF ISOTOPIC POWER SOURCES FOR TERRESTRIAL, MARINE, AND SPACE APPLICATIONS E. D. Arnold (Oak Ridge Natl. Lab., Tenn.) p 33–248 refs (See N65-20129 10-22)

4. SNAPS 9A AND 19 C. R. Fink and J. G. Morse (Martin Co., Baltimore) p 249–256 (See N65-20130 10-22)

5. RADIOISOTOPE SPACE PROPULSION SYSTEMS J. S. Martinez p 257–276 (See N65-20131 10-22)

N65-20127 Hanford Atomic Products Operation, Richland, Wash. Hanford Labs.
THE FISSION PRODUCTS
C. A. Rohrmann *In* AEC Conf. on Isotopic Power Develop. [1964] p 1–16 refs (See N65-20126 10-22)
(Contract AT(45-1)-1350) CFSTI: $6.00

Economic feasibility of recovering radioisotopes from fission products for use as heat sources is reported. Detailed characteristics of numerous radioisotopes are presented, in discussion of their possible use as heat sources. An engineering study was made of fission wastes at a radiation laboratory; a flow chart shows the waste processing at the plant. A program is described for safe disposal of high-level radioactive wastes by absorbing the long-lived heat producers, strontium 90 and cesium 137, on inorganic ion exchange materials. Plant operating costs are given for 1963; it was concluded that costs are relatively low for recovery of Sr-90, Cs-137, Ce-144, and Pm-147 in purified, encapsulated form. J.M.D.

N65-20129 Oak Ridge National Lab., Tenn.
HANDBOOK OF SHIELDING REQUIREMENTS AND RADIATION CHARACTERISTICS OF ISOTOPIC POWER SOURCES FOR TERRESTRIAL, MARINE, AND SPACE APPLICATIONS
E. D. Arnold *In* AEC Conf. on Isotopic Power Develop. [1964] p 33–248 refs (See N65-20126 10-22) CFSTI: $6.00

Calculations were made of the radiation intensities from shielded and unshielded sources fabricated from 17 isotopes that show promise for use in isotopic power or radiation applications. Source sizes in the range of 100 to 20000 thermal watts were evaluated. All shielded sources were assumed to be attenuated by iron, lead, and uranium; and in those cases where the source also emitted neutrons, neutron and gamma attenuation through water was determined. The isotopes studied and their physical form are as follows: Co^{60} (metal), Kr^{85} (liquefied gas), Sr^{90} (oxide and titanate), $Zr–Nb^{95}$ (oxide), Ru^{106} (metal), Cs^{137} (glass), Ce^{144} (oxide), Pm^{147} (oxide), Tm^{170} and Tm^{171} (both as oxides), Tl^{204} (metal), Po^{210} (metal matrix with void space for gas collection), U^{232} (oxide), Th^{228} (oxide matrix with void space for gas collection), Pu^{238} (oxide), Cm^{242} (oxide matrix with void space for gas collection), and Cm^{244} (oxide). Author

N65-20130 Martin Co., Baltimore, Md. Small Power Systems Dept.
SNAPS 9A AND 19
Jerome G. Morse and Charles R. Fink *In* AEC Conf. on Isotopic Power Develop. [1964] p 249–256 (See N65-20126 10-22) CFSTI: $6.00

The SNAP 9A performance difficulties in test and orbit are discussed; SNAP 19, the successor to SNAP 9A, is described. In the safety review preceding launch, it was necessary to modify the antenna design to achieve a satellite-generator configuration that would allow stable reentry from orbit. The first unit launched experienced a constant rate loss of internal pressure from 15 to 6 psia; in continuing orbit the rate of power loss has decreased with time. The SNAP 19 was designed as a multipurpose, safe, reliable, followup to SNAP 9A. Problems in choice of fuel capsule and heat accumulator are discussed. Drawings of SNAP 19 are shown. J.M.D.

N65-20131 Space Technology Labs., Inc., Redondo Beach, Calif. Propulsion Research Dept.
RADIOISOTOPE SPACE PROPULSION SYSTEMS
John S. Martinez *In* AEC Conf. on Isotopic Power Develop. [1964] p 257–276 (See N65-20126 10-22) CFSTI: $6.00

Radioisotope propulsion systems for providing lightweight upper stages and spacecraft with nuclear rocket performance are discussed. POODLE, a direct-cycle thruster in which the working fluid passes directly over the capsule wall and is heated by conduction and convection, is presented in detail. Its design, specific impulse, payload capacity, and performance in space flight are discussed. Another class of direct-cycle thrusters is described in which most of the radiation passes through the radioisotope capsule walls and deposits its energy in relatively thick tungsten heating elements over which the working fluid passes. It is concluded that costs of space mission could be significantly reduced through use of radioisotope-propelled stages in place of high-energy chemical stages. J.M.D.

N65-20200# National Reactor Testing Station, Idaho Falls, Idaho.
NUCLEAR TECHNOLOGY BRANCHES Quarterly Report, 1 Jul.–30 Sep. 1964
Feb. 1965 100 p refs
(Contract AT(10-1)-205)
(IDO-17052) CFSTI: $3.00

Results reported on the following studies include *Reactor Engineering*: (1) metallurgical development—corrosion testing of aluminum–beryllium alloys indicates that a 50 wt% alloy with lamellar beryllium grain structures has excellent resistance; and (2) critical facilities—the boron in each element was determined by making separate criticality runs, with each element placed in a core position in which a calibration curve of boron content versus shim positions was made; *Nuclear Technology*: (1) nuclear chemistry—swelling measurements were completed on beryllium samples cut from the midplane of MTR lattice piece LB-15; and (2) inelastic scattering—neutron diffraction patterns were determined at high pressures; *Instrument Development*: (1) detector development—the two devices developed to measure PBF fuel element radial and axial deflection are the radial expansion proving ring and a cantilever beam extensometer; and (2) instrumentation analysis and development—determination of fluid flow transients were determined in the ETR primary coolant system for a 36-$in.^2$ rupture in the upper plenum of the reactor vessel; and *Mathematical Analysis and Machine Computations*: definitions and methods of calculation of the reactor kinetics equation parameters—effective reactor kinetic equation parameters are found in the eigenvalues of certain reactor problems where these eigenvalues are computed by the reactor digital computer codes. R.W.H.

N65-20524# Air Force Systems Command, Kirtland AFB, N. Mex. AF Weapons Lab.
STUDY TO REDUCE AND COMPILE USAF NAP RADIATION EFFECTS DATA, SUPPLEMENT I
Daniel G. Emdee Feb. 1965 18 p
(WL-TDR-64-1, Suppl. 1; AD-612191)

This is a report on the continuing inhouse effort to reduce and compile data generated during irradiation tests performed on approximately 800 electronic piece parts to determine the effects of reactor-produced radiation on their operational characteristics. The devices were subjected to integrated neutron fluxes greater than 10^{15} n/cm^2 ($E>0.1$ MeV) and gamma doses in excess of 10^8 rad. A few of the devices were tested exclusively in a Co^{60} gamma source to approximately 8×10^7 rad. The data generated in the above tests were reduced to approximately six pertinent data points and recorded on computer library file cards and magnetic tape, along with information such as piece part application, manufacturer, manufacturing process, etc., concerning each part. A limited retrieval and printout program has been written for inhouse study of the collected data. Author

N65-20708# Oak Ridge National Lab., Tenn.
EVALUATION OF HASTELLOY F AND OTHER CORROSION-RESISTANT STRUCTURAL MATERIALS FOR A CONTINUOUS CENTRIFUGE IN A MULTIPURPOSE FUEL-RECOVERY PLANT

W. E. Clark, L. Rice, and D. N. Hess Apr. 1965 16 p refs
(Contract W-7405-ENG-26)
(ORNL-3787) CFSTI: $1.00

Hastelloy F was found suitable as a material of construction for a centrifuge to be used for clarifying solutions generated in various nuclear head-end processing schemes. The maximum corrosion rate was $\lesssim$0.7 mil/month in all solutions tested. Test temperature was 35° C. Candidate materials besides Hastelloy F included Carpenter 20SCb stainless steel, Hastelloy C, titanium-45A, and a vacuum-melted, low-carbon variation of Ni-o-nal. Hastelloy F was the only one of these materials which was satisfactorily resistant to all of the test solutions. Author

N65-20761# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation
HIGH-TEMPERATURE MATERIALS AND REACTOR COMPONENT DEVELOPMENT PROGRAMS. VOLUME 1: MATERIALS Fourth Annual Report
26 Feb. 1965 239 p refs
(Contract AT(40-1)-2847)
(GEMP-334A) CFSTI: $6.00

Eight unclassified material development programs are presented: (1) materials for use as fueled and unfueled, high-temperature reactor components; (2) radiation effects on the time-, temperature-, and stress-dependent properties of selected high-temperature alloys and refractory metals; (3) radiation effects in BeO as a function of composition, grain size, density, porosity, and irradiation temperature and dosage; (4) diffusion of fission gases (Kr, Xe, and I atoms) in ceramic oxides subsequent to their injection via ion bombardment; (5) fission product transport processes in refractory-metal fuel systems at temperatures exceeding 1700° C; (6) use and development of a fertile material (thoria) in stabilized fuel–BeO systems; (7) development of oxidation- and corrosion-resistant fuel element materials with improved high-temperature properties; and (8) high-temperature thermocouples and electrical materials development. R.W.H.

N65-20794*# Lockheed Nuclear Products, Marietta, Ga.
EFFECT OF NUCLEAR RADIATION ON MATERIALS AT CRYOGENIC TEMPERATURES Quarterly Progress Report No. 16, Oct.–Dec. 1964
C. A. Schwanbeck 26 Jan. 1965 57 p refs
(Contract NASw-114)
(NASA-CR-57750; ER-7702) CFSTI: HC $3.00/MF $0.50

Out-of-pile testing of some aluminum alloys was completed, and in-pile testing continued. A reactor operational decision was made to remove the gamma shield due to the buildup of W^{187} activity in the primary coolant system. Temperature control of Aluminum 1099 was temporarily lost due to the shutdown of the refrigerator; however, exposure was completed. Subsequent testing of this sample showed the effect of some annealing and diffusion of the irradiation-induced defects in reducing both the ultimate tensile strength and the tensile yield strength. Test results are tabulated for aluminum alloys 2024-T351, 1099, 2024, 2014, 2219, 5083, 5086, 5456, 6061, 7079, 7178, X-250, B-750, and A-356, and also for steel alloys A-353, 17-7PH, and T-450. R.W.H.

N65-20797*# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science
STUDIES OF THERMIONIC MATERIALS FOR SPACE POWER APPLICATIONS Informal Monthly Report, Oct. 1–Oct. 31, 1963
L. Yang, F. D. Carpenter, W. Holland, M. H. Horner, R. G. Hudson et al [1963] 28 p
(Contract NAS3-4165)
(NASA-CR-57655; GACD-4768) CFSTI: HC $2.00/MF $0.50

Fabrication developments for uranium carbide–zirconium carbide fuels, and for vapor deposition of tungsten are reported. Also, measurements of the high-temperature properties of uranium carbide–zirconium carbide; life-testing of cesium thermionic cells; and the results of irradiation studies are summarized. The fractional fission product release from uranium carbide–zirconium carbide, and the fuel temperature as a function of position from the aluminum wall are tabulated. Further, fission product diffusion through tungsten cladding, and the results of the fuel clad diffusion–emission studies are included. E.E.B.

N65-20798*# General Dynamics Corp., San Diego. John Jay Hopkins Lab. for Pure and Applied Science
STUDIES OF THERMIONIC MATERIALS FOR SPACE POWER APPLICATIONS Informal Monthly Report, Sep. 1–Sep. 30, 1963
L. Yang, F. D. Carpenter, M. H. Horner, R. G. Hudson, J. R. Lindgren et al [1963] 9 p
(Contract NAS3-4165)
(NASA-CR-57657; GACD-4730) CFSTI: HC $1.00/MF $0.50

Work on thermionic materials for space power applications continued with (1) *Fabrication Development*—isostatic cold pressing for uniformity of UC–ZrC specimens, and the effect of particle size on the pore structures of cold-pressed and sintered specimens; and (2) *Measurements of High-Temperature Properties of Thermionic Materials*—rate of vaporization as a function of pore structure of UC–ZrC; fission product release from UC–ZrC; fission product diffusion through W-clad; fuel-clad gross diffusion studies; fabrication of a Re-clad stoichiometric wafer and diffusion–emission cells from Re and Ir layers over W; mechanical properties of UC–ZrC; fabrication of a 30 UC-70 ZrC emitter containing 10 wt% W for emission microscopy; life-testing of cesium thermionic cells, and irradiation studies. G.G.

N65-20801*# General Dynamics Corp., San Diego. John Jay Hopkins Lab. for Pure and Applied Science
STUDIES OF THERMIONIC MATERIALS FOR SPACE POWER APPLICATIONS Informal Monthly Report, Dec. 1–Dec. 31, 1963
L. Yang et al [1963] 29 p refs
(Contract NAS3-4165)
(NASA-CR-57653; GACD-4923) CFSTI: HC $2.00/MF $0.50

Isostatic pressing and pore control in UC–ZrC fuel specimens are reported. The status of the work on vaporization rate of UC–ZrC as a function of pore structure is summarized. Measurements on the release of Xe^{133}, I^{131}, Te^{132}, and Ba^{140} were made at 1800° C on a cold-pressed and sintered 30UC–70ZrC sample of 77.6% theoretical density, irradiated to 10^{14} fissions. The sample was thermally stabilized at 2000° C for a period of 40 hours and had a specific surface area of 4025 cm^2/cc and a surface roughness factor of 236. Diffusion-emission studies were carried out at 2073° K on vapor-deposited tungsten clad hyperstoichiometric and hypostoichiometric uranium carbide. Also, a Re clad metal-rich uranium carbide was studied at 2073° K. A large change in emission was observed. E.E.B.

N65-20803*# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science
STUDIES OF THERMIONIC MATERIALS FOR SPACE POWER APPLICATIONS Information Monthly Report, Jan. 1–31, 1964

L. Yang et al [1964] 44 p refs
(Contract NAS3-4165)
(NASA-CR-57654; GACD-4990) CFSTI: HC $2.00/MF $0.50

Four areas of research were discussed: *Fabrication Development*—UC–ZrC fuels were prepared from powder fractions; Mobay multrathane was found impractical as an isostatic pressing medium; isostatic cold pressing of W-60V/oUO_2 cermets was unsuccessful; specimens of tungsten coated UO_2 were hot pressed; and the seal coating of carbide specimens was studied. *Studies of Properties of High-Temperature Thermionic Materials*—Measurements were made of the Langmuir rate of vaporization of sample A_2-1, and of fission product release characteristics at 1600°C on sample A_2-3; specific studies included those on fuel-clad gross diffusion, and refractory metal interdiffusion. *Life Testing Fueled Cesium Thermionic Converters*—Development continued on a cylindrical fuel emitter structure and on testing equipment. *Irradiation Studies*—Design layout of the capsule positioning mechanism, and the hydraulic cable drive system were considered. G.G.

N65-20853# India. Dept. of Atomic Energy, Bombay. Health Physics Div.
STUDY OF AIR BORNE RADIOACTIVITIES IN THE OPERATION OF A HIGH FLUX RESEARCH REACTOR (CIR)
S. D. Soman and P. Abraham 1964 28 p refs
(AEET/HP/TM-11)

This paper describes studies on radioactivity in the exhaust air from a 40-MW reactor. Gaseous and particulate activities were studied by decay and gamma-ray spectrum measurements. The gaseous activity is due to induced activities and gaseous fission products. The rate of release of argon-41 from the stack measured about 640 curies per day at 40MW; the rate of production of argon-41 in all the air spaces in the reactor structure is estimated to be 950 curies per day. The different methods adopted for the estimation of argon-41 are outlined. Radiocarbon produced by different reactions of neutrons with the constituents of air was estimated to be 7.24 curies per year. A simple form of electrostatic precipitator was used to collect daughter products of gaseous fission products. The beta decay of particulate activity collected on filter paper air samples from the exhaust system shows the presence of sodium-24 and some fission product activities; the presence of sodium-24 was confirmed by chemical analysis Author

N65-20876*# United Aircraft Corp., East Hartford, Conn.
ANALYTICAL STUDY OF MODERATOR WALL COOLING OF GASEOUS NUCLEAR ROCKET ENGINES
G. H. Mc Lafferty Washington, NASA, Apr. 1965 78 p
(Contract NASw-847)
(NASA-CR-214) CFSTI: HC $3.00/MF $0.75

A study investigated cooling problems in high-thrust cavity-type gaseous nuclear rocket engines resulting from heat deposition within the interior of the moderator–reflector surrounding the cavity by neutrons and gamma rays, and heat deposition on the surface of the cavity by fission fragments, beta particles, radiant heat transfer, and convection. The study included determination of the size and spacing of coolant tube passages required in the wall of the moderator–reflector and the pressure drop of the coolant fluid in these passages. A number of different coolant flow cycles were considered. The study indicates that more heat will be deposited in the interior of the moderator than on the surface of the cavity, but that the heat deposited on the surface of the cavity may be more difficult to remove. Removal of the energy deposited in the interior of the moderator will require the use of a large number of small-diameter coolant passages. The major causes of cavity surface heating will be beta-particle impingement and thermal radiation. Author

N65-20939# European Atomic Energy Community, Brussels (Belgium).
CRE: AN IBM 7090 CODE FOR THE DETERMINATION OF REACTIVITY CHANGES AND FLUX SHAPE DUE TO CONTROL ROD INSERTION IN A REACTOR
B. Dorpema, C. Mongini-Tamagnini, and C. Ponti Nov. 1964 39 p refs
(EUR-2162.e) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 60 Belg. Fr.

The CRE is a code designed for calculating the effect of complete insertion of a ring of cylindrical control rods in a cylindrical reactor. Two-group, one-dimension theory is used, with boundary condition for the fluxes to vanish at the external radius of the reactor and to have given extrapolation lengths into the rods. The extrapolation lengths can be given in input or can be calculated by the code itself in the hypothesis of black or grey rods. Author

N65-20953# Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf (Austria). Institut für Elektronik
BURN-UP DETERMINATION OF NUCLEAR FUEL BY HIGH-RESOLUTION GAMMA-SPECTROSCOPY
M. J. Higatsberger, H. Hick, K. Rumpold, and P. Weinzierl 10 Sep. 1964 17 p refs Presented at the 3d Intern. Conf. on the Peaceful Uses of Atomic Energy, Geneva, Sep. 1964
(Contract IAEA-180/RB)
(SGAE-PH-8/1964)

Cesium–barium-137 with a half-life of 30 years is a very favorable combination for burnup determination because of its long half-life and approximately equal yields for U-235 and Pu-239 fission. For normal fuel-element utilization times, up to 3 years, the time factor can be estimated with good accuracy without information on reactor operation. Because of the equality of fission yields for the mass number 137, the determination of Cs-137 leads directly to the sum of U-235 and Pu-239 fissions in a fuel containing only these two fissile isotopes. However, the measurement of the 661 keV line requires a high resolution gamma spectrometer. For cooling times on the order of weeks, the 661-keV line is very difficult to measure due to the stronger gamma lines from other fission products. With a cooling time of 2 weeks for an irradiation time of 2 years, the separation of the cesium-137 peak from the three stronger Zr–Nb-95 peaks was achieved. E.E.B.

N65-21076# European Atomic Energy Community, Brussels (Belgium).
IN-PILE APPLICATION OF STRAIN GAUGES
P. W. Weltevreden Dec. 1964 14 p refs Presented at the Symp. on In-Core Instrumentation, Oslo, 15–19 Jun. 1964
(EUR-2120.e) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 25 Belg. Fr.

This report outlines research on the inpile application of strain gages. Its scope is merely to focus the attention on this subject. To this extent a concise description of the background of the problem is given, followed by a summary of the experimental data available in this field up to now. Next, the research program, actually in course, is presented and a point is made concerning the situation to date. Ultimately, a description of the irradiation rigs as prepared for the Ispra-I reactor and the high flux reactor in Petten is given, together with their out-of-pile equipment. Author

N65-21079# European Atomic Energy Community, Brussels (Belgium).
THERMAL INSULATION OF AN ORGEL TYPE CHANNEL BY A STAGNANT GAS FILM [ISOLEMENT THERMIQUE D'UN CANAL ORGEL PAR UNE LAME DE GAZ STAGNANT]
J. Fauré and E. Labarre Dec. 1964 71 p refs In FRENCH; ENGLISH summary
(EUR-2175.f) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 100 Belg. Fr.

The heat transfer between a gas-insulated reactor channel of the Orgel type and the moderator depends on the temperature distribution, construction materials, the average thickness of the annular gas space, on its eccentricity and on the kind and the pressure of the insulating gas. The influence of these parameters on the heat transfer was studied and thermal losses were calculated in various experimental conditions. The temperature difference between external tube and heavy water, consequent on the above phenomenon, together with the temperature values and the area of the hot points caused by the spacers are discussed. Author

N65-21080# European Atomic Energy Community, Brussels (Belgium).
GAMMA HEAT GENERATION IN THE 4GV1 BEAM OF THE ISPRA-I REACTOR
C. Bassani and P. Cerutti Dec. 1964 38 p refs
(EUR-2178.e) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 50 Belg. Fr.

Methods of measuring gamma heat generation in the experimental beam 4GV1 of the Ispra-I Reactor are described. Data from a calorimetric method and a graphite CO_2 ionization chamber are presented. A theoretical evaluation of the gamma heat generation in the measuring position, worked out for comparison with the experimental results, is also included. Author

N65-21121# European Atomic Energy Community, Brussels (Belgium).
FABRICATION OF URANIUM CARBIDE FUEL RODS CANNED WITH SAP FOR IRRADIATION IN THE NRX REACTOR—EXPERIMENT NRX 716 [REALISATION DE CRAYONS COMBUSTIBLES EN CARBURE D'URANIUM GAINE DE SAP POUR IRRADIATION DANS LE REACTEUR NRX—EXPERIENCE NRX 716]
R. Klersy, G. Musso, G. Detiffe, and J. P. Lecoq 1964 72 p refs In FRENCH; ENGLISH summary
(EUR-2158.f) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 100 Belg. Fr.

This report describes the fabrication of a number of fuel rods for irradiation tests. It deals with the preliminary testing of the materials used and the testing of finished fuel elements. Author

N65-21124# Battelle Memorial Inst., Columbus, Ohio.
IN-PILE FISSION-GAS RELEASE FROM URANIUM CARBIDE AND URANIUM NITRIDE
James B. Melehan and John E. Gates 18 Nov. 1964 58 p refs
(Contract W-7402-ENG-92)
(BMI-1701)

In-pile fission-gas release behavior of cast $UC_{0.9}$, $UC_{1.01}$, $UC_{1.04}$, and $UC_{1.4}$, sintered $UC_{1.04}$(93% dense), and $UN_{1.01}$(92% to 96% dense) was studied at temperatures up to 1700° C. Fission-gas release from $UN_{1.01}$ was temperature independent up to about 800° C. Above 800° C release was temperature dependent and could be described in terms of diffusion theory. Limited data suggest that between 1000° and 1600° C the fission-gas diffusion coefficients in sintered $UC_{1.04}$ are comparable to those for sintered $UN_{1.01}$. Fission-gas release from the cast carbides was temperature dependent between 1000° and 1600° C but never exceeded the theoretical recoil release. At 1600° C the rate of fission-gas release in $UC_{1.01}$ and $UC_{1.4}$ was equal but at lower temperatures the release rate in $UC_{1.01}$ was higher than in $UC_{1.4}$. This higher release rate might be related to the presence of the interconnected UC_2 second phase in the $UC_{1.01}$ alloy. Author

N65-21134# Oak Ridge National Lab., Tenn.
EFFECTS OF FAST-NEUTRON IRRADIATION AND HIGH TEMPERATURE ON BERYLLIUM OXIDE
R. P. Shields, J. E. Lee, Jr., and W. E. Browning, Jr. 2 Apr. 1962 89 p refs
(Contract W-7405-ENG-26)
(ORNL-3164) CFSTI: $2.00

Beryllium oxide bodies irradiated in the engineering test reactor experienced changes ranging from negligible to major, including complete deterioration to a fine powder. The greatest damage appeared in bodies irradiated for high neutron doses at low temperatures. Greater doses could be tolerated at higher temperatures. Changes in linear dimensions up to 4% were observed. Helium was retained even at irradiation temperatures of 1025° C. Gases could be removed only by dissolving the BeO in fused salt. Voids 0.1μ to 0.3μ in diameter not in the original material were found by electron microscopy in the interior of grains and at grain boundaries. No evidence of chemical decomposition was observed. Author

N65-21143# European Atomic Energy Community, Brussels (Belgium).
A REFERENCE DESIGN FOR A 250 MWe ORGEL-TYPE POWER STATION ["REFERENCE DESIGN" D'UNE CENTRALE ORGEL DE 250 MWe]
A. Bahbout and S. Orlowski Dec. 1964 63 p refs in FRENCH; ENGLISH summary
(EUR-2190.f) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 85 Belg. Fr.

A reference design for a 250-MWe ORGEL-type power station was studied. In this report, comments are made on the various basic choices such as the magnitude of the installed power, the layout of the reactor, the selection of core materials, the fuel management, etc. Solutions to the various design problems are briefly recalled and commented on. Author

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N65-20165*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LIOUVILLE'S EQUATION AND THE n-BODY PROBLEM
R. G. Langebartel Washington, NASA, Apr. 1965 60 p refs
(NASA-TR-R-217) CFSTI: HC $3.00/MF $0.50

The motion of system of particles is examined on the basis of the fundamental equation in statistical mechanics. The Dirac delta function is used to describe systems discrete in position space, velocity space, or both as degenerate cases of

continuous systems. The approximation procedure, necessitated by the nonlinearity of the problems, is based on the use of expansions in successive derivatives of the delta function. This approach leads to sum-difference-differential equations of a novel form for the quantities of interest, equations subject to a variety of techniques for solution. Author

N65-20211 Joint Publications Research Service, Washington, D. C.
QUANTUM PREDICTION OF RANDOM ELECTROMAGNETIC PROCESSES
V. V. Mityugov *In its* Izv. VUZov: Radiophys., Vol. VII, No. 5, 1964 11 Mar. 1965 p 48–55 refs (See N65-20205 10-10)
CFSTI: $6.00

Formulas are obtained for the extrapolation of electromagnetic field intensities from mean values from measurement at a series of points in the space–time domain. The derivation is based on the principle of maximum disinformation using the operational determination of entropy. Formulas are obtained for the quantity of information associated with such a measurement and with the concrete realization of a random process of given spectral power within a finite time interval. Author

N65-20247# McGill Univ., Montreal (Quebec). Eaton Electronics Research Lab.
ULTRAVIOLET ABSORPTION SPECTRA OF MnF_2, $KMnF_3$, $RbMnF_3$, AND $CsMnF_3$
Richard Stevenson Dec. 1964 31 p refs
(Contract Nonr-3013(00))
(AD-610124)

Absorption spectra in the 3000 to 4000 Å region are presented for MnF_2, $KMnF_3$, $RbMnF_3$, and $CsMnF_3$ at room temperature, liquid air temperature, and liquid helium temperature. The spectra are similar at room temperature, but marked differences appear at low temperatures due to the occurrence of an antiferromagnetic phase transition. The spectra are classified, and calculations of the positions of the room-temperature lines are given in terms of a modification of ligand field theory. Values of the crystal field splitting and of a covalency parameter are given for the four crystals. Some classification of the low-temperature lines is made in terms of the phenomena causing their occurrence. Author

N65-20450# RAND Corp., Santa Monica, Calif.
A NEW DERIVATION OF THE INTEGRO-DIFFERENTIAL EQUATIONS FOR CHANDRASEKHAR'S X AND Y FUNCTIONS
R. Bellman, H. Kagiwada, R. Kalaba, and S. Ueno Dec. 1964 11 p refs
(Contract ARPA SD-79; ARPA Order 189-61)
(RM-4349-ARPA; AD-610061)

The X and Y functions of Chandrasekhar are of great importance in the theory of multiple scattering in a finite slab. Their properties are best determined analytically through the use of integral equations. From the computational view, though, they are best treated as solutions of a system of integrodifferential equations. Our aim is to produce a derivation from first principles which illuminates the nature of the integrodifferential equations and which will aid us in our computational studies of transport processes. Author

N65-20454# American Meteorological Society, Boston, Mass.
THE EFFECT OF A FOREIGN GAS ON THE ABSORPTION SPECTRUM NEAR A SERIES LIMIT, PART II [VLIIANIE INORODNOGO GAZA NA SPEKTR POGLOSHCHENIIA VBLIZI GRANITSY, SERII II]
O. B. Firsov Bedford, Mass., AFCRL [1964] 18 p refs Transl. into ENGLISH from Zh. Eksperim. Teor. Fiz. (Moscow), v. 21, no. 5, 1951 p 634–641
(Contract AF 19(604)-6113)
(T-R-418; AD-610114)

The shape of spectral lines is determined from the expression for the shift of a spectral atomic line in a foreign gas. Characteristic functions are used in the derivation. Thermal molecular motion is not considered, consequently, the theoretical curves of line width as a function of the principal quantum number lie below the experimental curves. Author

N65-20531# Army Chemical Center, Edgewood, Md. Physicochemical Research Div.
REBOUND OF LIQUID DROPS FROM A SOLID SURFACE
Albert Pfeiffer Jul. 1964 24 p refs
(CRDLR-3220; AD-610625)

The mechanics of rebound of drops are described, using a new method of high-speed photography. A list of the factors influencing the rebound of these drops and a qualitative explanation of the phenomenon and the energy relations involved in the rebound are given. It is concluded that fine aerosol drops, impacting on a solid surface, rebound from that surface under certain conditions and that in the calculation of impaction efficiency, the assumption that all particles that impact on a surface are assumed to adhere to it can give erroneous results under the conditions causing rebound. Under such conditions, the results of these calculations may be corrected by factors obtained experimentally. Author

N65-20538# Toronto Univ. (Ontario). Inst. for Aerospace Studies
THE MEASUREMENT OF ENERGY TRANSFER IN GAS—SOLID SURFACE INTERACTIONS USING ELECTRON BEAM EXCITED EMISSION OF LIGHT
D. J. Marsden Nov. 1964 85 p refs
(Grant AF-AFOSR-276-64)
(UTIAS-101; AFOSR-64-2482; AD-612017)

A new approach to the measurement of energy accommodation of a rarefied gas at a solid surface is described. Gas molecules from a surrounding gas in thermal equilibrium and at rest are incident on a cooled metal target disc. Under conditions of free-molecule-flow the incident molecules are not disturbed by the cooler reflected molecules. A high energy electron beam is passed through the gas in front of the target disc and parallel to it, exciting the gas to electroluminescence. The rotational energy distribution and number density of molecules can be determined from a spectrographic analysis of the light emitted by the gas. The contribution to the measured intensity of spectrum lines due to the incident molecules can be determined with the target retracted. This contribution is then subtracted from total light intensity measurements made with the target in position in order to get the rotational energy distribution and number density of the reflected molecules alone. These measurements can be interpreted to obtain values of energy accommodation coefficients, both for the translational and rotational degrees of freedom of the gas. Author

N65-20610# General Technology Corp., Elgin, Ill.
PLANE SPIRAL SPRING UNDER UNIFORM ROTATION ABOUT ITS ARBOR
Huo-Hsi Pan Aug. 1964 50 p refs
(Contract DA-11-022-AMC-168(A))
(TRX-1; AD-609920)

Under the assumption of the inextensibility of the spring element, a solution is obtained based on the energy principle

by considering the bending energy only. When special cases are taken, it is shown that this solution yields results which agree with the known results. As any specific solution will depend on the given shape of the spiral, a procedure to obtain the specific solution for any given spiral shape is outlined. In addition, a specific solution to an assumed spiral shape of common usage is also presented. This may serve as an approximation to the problem of other but not too different spiral shapes. Author

N65-20623*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
DIPOLE MATRIX ELEMENTS IN HELIUM IN THE FIRST ORDER SHIELDING APPROXIMATION
Kenneth M. Sando and Saul T. Epstein 3 Mar. 1965 18 p refs
(Grant NsG-275-62)
(NASA-CR-57587; WIS-TCI-82) CFSTI: HC $1.00/MF $0.50

The first-order shielding approximation is used to calculate off-diagonal matrix elements of the dipole moment operator for helium. The transitions considered are the 2'S to 2'P and the 1'S to 2'P transitions. When compared with Pekeris' accurate theoretical values, the results calculated here are in error by about 5% for the 2'S to 2'P transition and by about 15% for the 1'S to 2'P transition. Author

N65-20624*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
PHASE SHIFTS AND THE QUANTUM MECHANICAL HAMILTON-JACOBI EQUATION
Donald J. Kouri and C. F. Curtiss 1 Mar. 1965 37 p refs
(Grant NsG-275-62)
(NASA-CR-57579; WIS-TCI-81) CFSTI: $2.00/MF $0.50

A method of obtaining absolute phase shifts by integration of the quantum mechanical Hamilton–Jacobi equation is developed and applied to the example of particles interacting through a Lennard–Jones potential. A new expression for the absolute phase shift is obtained in terms of an irregular solution of the Schroedinger equation. Author

N65-20716# Illinois Univ., Urbana. Aeronautical and Astronautical Engineering Dept.
A SUMMARY OF LINEAR VISCOELASTIC STRESS ANALYSIS
Harry H. Hilton Mar. 1965 56 p refs
(AAE-65-2)

Present developments in linear viscoelastic stress analysis with emphasis on solid propellant grain analysis are summarized. Papers, books, and articles pertaining to the stress–strain relations and stress and strain analysis in linear viscoelastic bodies are reviewed. The use of perturbation techniques reduces the solution of actual nonlinear viscoelastic problems to a series of linear viscoelastic formulations with equivalent known body forces. The different linear viscoelastic properties depending on actual stress and strain levels in the various regions of the grain can be used to approximate the actual behavior of solid propellants. The linear viscoelastic analysis proved inadequate to predict finite critical times in problems involving instability. A number of fundamental problem areas of linear quasi-static and dynamic thermoviscoelasticity with time and space dependent material properties remain unsolved. G.G.

N65-20750# Purdue Univ., Lafayette, Ind. School of Aeronautics, Astronautics, and Engineering Sciences
INTEGRAL CONSTITUTIVE EQUATIONS OF NONLINEAR THERMO-VISCO-ELASTICITY
George Lianis Jan. 1965 43 p refs
(Grant NSF GP-2677)
(A&ES 65-1)

A recently developed thermodynamic theory of continuum mechanics is used to derive specific forms of constitutive equations for finite linear and nonlinear viscoelasticity. Assumptions beyond the general principles used in continuum physics are necessary to incorporate temperature history. The theory of thermorheologically simple materials, successfully used in infinitesimal viscoelasticity, is extended to finite viscoelasticity. Author

N65-20758*# Space Technology Labs., Inc., Redondo Beach, Calif. Quantum Physics Lab.
THEORETICAL INVESTIGATION; THE SCATTERING OF LIGHT BY A PLANETARY ATMOSPHERE Final Report, 1 Jun.–1 Dec. 1964
Robert S. Fraser [1964] 125 p refs
(Contract NAS5-3891)
(NASA-CR-57740; STL-4167-6002-RU-000) CFSTI: HC $4.00/MF $1.00

A theoretical-computational study is presented on how specular reflection at the ground modifies the light scattered outwards from the top of a homogeneous Rayleigh atmosphere. The computations for this model are compared with computations for a second model, which is the same, except that its ground reflects radiation according to Lambert's law. When their atmospheric optical thickness (τ_1) is not large ($\tau_1 < 1.0$), the relative difference is small for the flux, increases for the specific intensity, becomes large for the maximum degree of polarization, and is still larger for the neutral point positions. The neutral point characteristics for the two models are quite different for optical thickness smaller than 0.25. The flow of the radiation is divided into several streams that have physical significance and can be calculated separately. Author

N65-20774# RAND Corp., Santa Monica, Calif.
ON THE EFFECTS OF STRESS-WAVE DIFFRACTION ON GROUND-SHOCK MEASUREMENTS: PART I
C. C. Mow Jan. 1965 60 p refs
(Contract AF 49(638)-700)
(RM-4341-PR; AD-610337)

An exact solution is presented of the response of a rigid spherical object (inclusion) embedded in an elastic medium subjected to ground shock. The Fourier-transform method was used to determine the transient response of the spherical inclusion. It was found that the inclusion motion differs substantially from the free-field motion, both in acceleration and velocity. A slight change in displacement was also observed. The effect of geometry on the response of an inclusion was also investigated briefly. It was shown that the frequency response of a cylindrical inclusion is quite similar to that of the spherical inclusion. On the basis of these study results, it is believed that a substantial error could occur in shock measurements due to stress-wave-diffraction phenomena. Author

N65-20781 Joint Publications Research Service, Washington, D. C.
BEAT FREQUENCIES OF WAVE MODES OF A LONG OPTICAL RESONANT CAVITY
Hsi-ming Kuo, Chou Hang, T'ien-li Yang, and Hsueh-ming Yen *In its* Transl. on Communist China's Sci. and Technol., No. 163 24 Mar. 1965 p 111–115 refs Transl. into ENGLISH from K'o-hsueh T'ung pao (Peking), no. 1, Jan. 1965 p 67–68 (See N65-20778 10-34) CFSTI: $4.00

Experimental results on the beat frequencies of the wave modes of a long optical resonant cavity are reported. A helium–neon gas mixture external cavity laser was used. The length of the quartz discharge tube was 208 cm, total pressure was 1.1 mm Hg, and the ratio of helium pressure to neon pressure was 10:1. A high frequency external electrode was used to excite waves of 6328 Å. The resonant cavity was composed of two reflecting mirrors with a radius of curvature of 390 cm, painted with 19 layers of MgF_2–ZnS film. Comparison of the single wave mode output pattern with theoretical calculation showed no obvious distortion. Beat signals were observed with the strongest beat signal reaching 1×10^{-2} of the direct current part of the photomultiplier output. The beat frequencies of transverse and longitudinal modes were also measured. E.E.B.

N65-20817# California Univ., Santa Barbara. Physics Dept.
QUANTITATIVE STUDIES BY OPTICAL SPECTROSCOPY OF ENERGY EXCHANGE MECHANISMS IN SIMPLE GASES AND SOLIDS
H. P. Broida 1 Jan. 1965 30 p refs
(Contract Nonr-4222(01); ARPA Order 125)
(TR-2; AD-610094)

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2. POPULATION INVERSIONS IN THE $B^2\Sigma$ STATE OF N_2^+ J. L. Dunn p 12–14 refs (See N65-20819 10-12)
3. VIBRALUMINESCENCE OF CO_2, N_2O, AND CO IN ACTIVE NITROGEN E. L. Milne and J. L. Dunn p 15–17 refs (See N65-20820 10-06)
4. THE BRUSH CATHODE PLASMA IN HYDROGEN G. A. Woolsey p 18–22 refs (See N65-20821 10-23)
5. VELOCITY OF SOUND IN VAN DER WAALS CRYSTALS S. L. Shapiro p 23–24 (See N65-20822 10-26)
6. FREE CARRIER MOBILITY IN SOLID AND LIQUID RARE GASES H. D. Pruett p 25–27 refs (See N65-20823 10-26)
7. A SPECTROSCOPIC STUDY OF THE CHANGE TRANSFER MECHANISMS IN BENZENE IODIDE J. S. Margolis 3 p (See N65-20824 10-06)

N65-20882*# National Aeronautics and Space Administration, Washington, D. C.
THE EMISSIVE POWER OF WATER IN THE INFRARED REGION OF THE SPECTRUM [IZLUCHATEL'NAYA SPOSOBNOST' VODY V INFRAKRASNOY OBLASTI SPEKTRA]
M. A. Bramson, I. L. Zel'Manovich, and G. I. Kuleshova Apr. 1965 43 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 152, 1964 p 31–67
(NASA-TT-F-319) CFSTI: HC $2.00/MF $0.50

The results are presented of calculations performed by the Ural computer to determine the spectral and spatial distribution of radiation coefficients of water, taking into account the complex coefficient of refraction. Author

N65-20980*# Oslo Univ., Blindern (Norway). Inst. for Theoretical Physics
RESONANCE METHOD IN SCATTERING THEORY
Egil A. Hylleraas [1963] 21 p refs Prepared in part at Wisconsin Univ. and Florida Univ. *Its* Rept.-18
(Grant NsG-275-62)
(NASA-CR-53092; WIS-TCI-14)

The aim is to replace the ordinary treatment of the scattering problem by an indirect one. This can be done by providing the scattering potential with an adjustable numerical factor which is used as an eigenvalue parameter of a discrete eigenvalue problem. The term resonance method alludes to the structure of the formulas. Author

N65-20989*# National Aeronautics and Space Administration, Washington, D. C.
TABLES FOR COMPUTING THE SPECTRUM OF THE PARTICLES OF A DISPERSED SYSTEM FROM ITS TRANSPARENCY [TABLITSY DLYA RASCHETA SPEKTRA CHASTITS DISPERSNOY SISTEMY PO YEYE PROZRACHNOSTI]
K. S. Shifrin, A. Ya. Perel'man, and L. K. Potekhina Apr. 1965 23 p Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 152, 1964 p 192–211
(NASA-TT-F-329) CFSTI: HC $1.00/MF $0.50

Equations are presented for calculating the spectrum of the particles of a dispersed system from data on its transparency, together with detailed tables for the special functions used in the problem. Author

N65-21003*# Consultants and Designers, Inc., Arlington, Va.
EFFECTIVE REFLECTING SURFACE OF AN IONIZED REGION HAVING THE SHAPE OF A SPHERE [OB EFFEKTIVNOY OTRAZHAYUSHCHEY POVERKHNOSTI IONIZIROVANNOY OBLASTI, IMEYUSHCHEY FORMU SHARA]
N. P. Mar'yin 31 Mar. 1965 15 p refs Transl. into ENGLISH from Radiotekhn. i Elektron. (Moscow), v. 10, no. 2, 1965 p 235–244
(Contract NAS5-3760)
(NASA-TT-F-9661; ST-RWP-AI-10309) CFSTI: HC $1.00/MF $0.50

A geometrical optics method is applied in this work in order to solve the problem of plane radiowave reflection from a sphere-like plasma region, in which the dielectric constant depends only on a single coordinate r. The intensity of the reflected field is plotted as a function of the angle θ. The decrease in density of electromagnetic energy flux at the expense of energy absorption in the ionized region is ascertained. Author

N65-21035# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics
RESEARCH ON NEW CONCEPTS IN ENERGY CONVERSION Quarterly Technical Progress Report, 1 Dec. 1964–28 Feb. 1965
W. D. Jackson, G. A. Brown, J. L. Kerrebrock, and R. E. Stickney Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., 15 Mar. 1965 34 p refs
(Contract AF 33(615)-1083)
(QTPR-6; AD-612710)

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3. MAGNETOHYDRODYNAMIC INDUCTION MACHINE WITH LAMINAR FLUID FLOW E. S. Pierson and W. D. Jackson p 4–17 refs (See N65-21036 10-25)
4. BEHAVIOR OF DRY POTASSIUM VAPOR IN ELECTRIC AND MAGNETIC FIELDS J. L. Kerrebrock, M. A. Hoffman, and A. Solbes p 18–23 refs (See N65-21037 10-26)
5. BONDING MECHANISM OF ALKALI-METAL ATOMS ADSORBED ON METAL SURFACES J. W. Gadzuk p 24–30 refs (See N65-21038 10-24)

N65-21100# RAND Corp., Santa Monica, Calif.
DECELERATION AND MASS CHANGE OF AN ABLATING BODY DURING HIGH-VELOCITY MOTION IN THE ATMOSPHERE
Carl Gazley, Jr. Jan. 1965 41 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4270-PR; AD-610287)

This memorandum examines the factors affecting the dynamics and mass loss of ablating bodies moving at high velocities in a gaseous medium. The interdependent deceleration and rate of mass loss make the problem more complex than the simple case of deceleration of a body of constant mass. Although a solution exists for the classic meteor case with constant heat-transfer and drag coefficients, results have not been available for cases where these coefficients vary during the deceleration process, e.g., large bodies moving in the lower atmosphere. This memorandum presents some analytic solutions for specific variations of the heat-transfer coefficient and suggests an approximation for other types of variations. Author

N65-21141# Joint Publications Research Service, Washington, D. C.
EXPERIMENTAL NONLINEAR OPTICS
S. A. Akhmanov and R. V. Khokhlov 6 Apr. 1965 30 p Transl. into ENGLISH from the book "Problemy Nelineynoy Optiki" Moscow, 1964 p 255–282
(JPRS-29459; TT-65-30665) CFSTI: $2.00

The nonlinear effects discussed have to do with the reactive nonlinearity of optically transparent media. The results presented are based either on model concepts or on general considerations based on statistical theory. The nonlinear effects considered are first-order effects with respect to the small parameters—the anharmonicity parameter and a parameter that characterizes the ratio of charged particle displacement to the wavelength. Consideration of saturation effects in negative temperature systems, related directly to laser theory have been omitted. Also, the nonlinear effects in semiconductors have been omitted. E.E.B.

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N65-20128 Oak Ridge National Lab., Tenn.
ISOTOPIC POWER DATA SHEETS
S. J. Rimshaw, comp. *In* AEC Conf. on Isotopic Power Develop. [1964] p 17–32 (See N65-20126 10-22) CFSTI: $6.00

Nuclear and physical properties are listed of some radioactive materials having potential application to terrestrial, marine, and aerospace power requirements. The data here are limited to unclassified source materials of ^{60}Co, ^{90}Sr, ^{137}Cs, ^{144}Ce, ^{147}Pm, ^{242}Cm, and ^{244}Cm. It will be obvious from reviewing the data sheets that experimental information on the properties of radioactive materials is very incomplete. Where such information is not available, literature values derived from the inactive materials or related materials have been used to indicate the probable order of magnitude of the value. Future data compilations will include more isotopes and materials. The information will be presented in the form of a manual or handbook in order to increase the space available for presenting and evaluating the data that are available. Provisions will be made for additions or deletions of data to keep the information current and meaningful. Author

N65-20150# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.
SLOW NEUTRON INELASTIC SCATTERING FROM ALUMINUM POWDER
R. M. Brugger and P. D. Randolph Feb. 1965 25 p refs
(Contract AT(10-1)-205)
(IDO-17063) CFSTI: $2.00

Measurements of the slow neutron inelastic scattering from a sample of polycrystalline aluminum, of transmission 0.87, were made. Measurements were made with and without thin cadmium spacers in the sample to examine the effects of multiple scattering, which are most pronounced at small momentum transfers, the cadmium producing as much as a 40% decrease in the elastic scattering data. Calculations of the frequency distributions in the incoherent approximation were made at several fixed values of momentum transfer κ in the hope that some value of κ would become apparent where this calculation would give a valid result. No such value was found. The first moments of the energy transfer at different values of κ were calculated and these agree well with theoretical predictions except at small momentum transfers where multiple scattering is large. Author

N65-20160# Oak Ridge National Lab., Tenn. Neutron Physics Div.
STATISTICAL MODEL CALCULATIONS OF NUCLEON-NUCLEON AND PION-NUCLEON COLLISIONS: LABORATORY ENERGY-ANGLE DISTRIBUTIONS ASSUMING ISOTROPY IN THE CENTER-OF-MASS SYSTEM
R. G. Allsmiller, Jr. Nov. 1964 161 p refs
(Contract W-7405-ENG-26)
(ORNL-3716) CFSTI: $5.00

In a previous report statistical model calculations for nucleon–nucleon and pion–nucleon collisions were carried out, and results were presented for the center-of-mass energy spectra of both pions and nucleons. In this report these spectra have been transformed into the laboratory system on the basis of the assumption that the angular distributions of both nucleons and pions are isotropic in the center-of-mass system. Laboratory energy-angle distributions of nucleons and pions are given for all collision conditions considered in the previous report. Author

N65-20169 Services Electronics Research Lab., Baldock (England).
YIELD FROM BAKABLE ERBIUM TARGETS FOR NEUTRON GENERATORS
L. N. Large and H. Hill *In its* S.E.R.L. Tech. J., Vol. No. 1, Feb. 1965 [1965] 7 p refs Submitted for Publication (See N65-20166 10-16)

The neutron yield from deuterided erbium and titanium targets was directly compared by bombarding a number of these targets with a beam of deuterons of energy between 60 and 130 keV. The average neutron yield for the rare-earth targets even after vacuum baking at 420° C was found to be very similar to that for titanium targets loaded to an atomic ratio of 1:4. The percentage spread in yield after baking is considerably lower than for the titanium targets assessed. The use of rare-earth targets, which can be run at higher temperatures than titanium without losing the occluded gas, enables

higher target dissipation to be used, thus resulting in greater total neutron yield. Author

N65-20229 Joint Publications Research Service, Washington, D. C.
THE FORM OF THE SPECTRAL LINE IN A BEAM OF MOLECULES
A. F. Krupnov and V. A. Skvortsov *In its* Izv. VUZov: Radiophys., Vol. VII, No. 5, 1964 11 Mar. 1965 p 243-245 refs (See N65-20205 10-10) CFSTI: $6.00

Spectral line during the interaction of a beam of molecules with a low-intensity field of arbitrary configuration was investigated. An experiment was done on the formaldehyde molecule, using a beam molecular generator with Fabry-Perot resonator. A probability function was stated for transition of a molecule from higher to lower energy in flight through a field of superhigh frequency which is used in finding the form of the spectral line in the resonator for a weak signal. Formulas are given for the spectral line. J.M.D.

N65-20230 Joint Publications Research Service, Washington, D. C.
NEW METHOD OF TUNING THE FREQUENCY OF A MOLECULAR GENERATOR BY HIGH-VACUUM MODULATION IN THE VACUUM CHAMBER OF THE GENERATOR
G. M. Strakhovskiy and V. M. Tatarenkov *In its* Izv. VUZov: Radiophys., Vol. VII, No. 5, 1964 11 Mar. 1965 p 246-248 refs (See N65-20205 10-10) CFSTI: $6.00

Experimental data on the dependence of the frequency of a molecular generator on the pressure in its vaccum chamber are presented. Dependency curves are shown for various generator frequencies; each of these curves is linear for pressures up to 1×10^{-5} mm Hg, but deviates from linearity beyond that. Based on these observations, and a differential equation for the observed curves, a vacuum-modulation method was devised for tuning the generator to the apex of the spectral line. The frequency to which the generator is tuned depends on the pressure in the source of the beam; experimental data on this dependency are shown. The method is said to be particularly useful for double-beam generators, as it does not disturb the symmetry of the beams. J.M.D.

N65-20231 Joint Publications Research Service, Washington, D. C.
NEW METHODS OF PRODUCING A BEAM OF SLOW MOLECULES FOR A MOLECULAR GENERATOR
G. M. Strakhovskiy and V. M. Tatarenkov *In its* Izv. VUZov: Radiophys., Vol. VII, No. 5, 1964 11 Mar. 1965 p 249-250 refs (See N65-20205 10-10) CFSTI: $6.00

A bent sorting system is proposed for producing a beam of molecules whose average velocity is considerably less than their thermal velocity at room temperature. Its function will be to channel into a resonator only those active molecules with velocity below some specified level. An experimental system, constructed with a 30° radius of curvature, was used to produce an induced-radiation signal on an ordinary receiver of a molecular generator, and a signal-to-noise ratio of about 3 was observed. An inequality is presented for determining the ratio of the maximum velocity of NH_3 molecules that have passed through a bent four-pole capacitor to the mean thermal velocity of NH_3 gas at room temperature. J.M.D.

N65-20397# Columbia Univ., Irvington, N. Y. Nevis Labs.
THE BRANCHING RATIO FOR PION BETA DECAY
David Bartlett (Ph.D. Thesis) Nov. 1964 109 refs
(Contract Nonr-266(72))
(NEVIS-127; R-468; CU-233; AD-610065)

The conserved vector current theory predicts that the branching ratio for the decay of a charged pion into a neutral pion is $(1.05 \pm 0.02) \times 10^{-8}$, if the coupling constant is derived from muon decay, or $(1.00 \pm 0.02) \times 10^{-8}$, if the coupling constant is derived from nuclear beta decay. Using spark chambers to distinguish the nearly anticollinear gamma rays from π^+ beta decay from a background of other gamma rays, 36 events were found measured; the branching ratio, $(0.97 \pm 0.20) \times 10^{-8}$, agreed with the theoretical prediction and previous measurements. The method of background subtraction ($\lesssim 10\%$) depends only on knowing that the background is isotropic for gamma rays having opening angles between 160° and 180°. Author

N65-20451# McGill Univ., Montreal (Quebec). Eaton Electronics Research Lab.
MULTIPLET ENERGIES OF d^n CONFIGURATIONS IN OCTAHEDRAL FIELDS
Richard Stevenson Nov. 1964 11 p refs
(Contract Nonr-3013(00))
(AD-610123)

The technique of Racah and Shadmi for accurate calculation of the multiplet energies of d^n free atom systems is used to given a partial revision of Tanabe and Sugano's tables for octahedral field multiplets. The tables also indicate the effects of covalency as shown by a diminution of the λ_3 orbitals. Author

N65-20470# Air Force Systems Command, Kirtland AFB, N. Mex. AF Weapons Lab.
A LEAST-SQUARES METHOD FOR THE ANALYSIS OF PROTON-PROTON SCATTERING DATA
David J. Knecht Nov. 1964 99 p refs
(WL-TDR-64-78; AD-610004)

Convenient formulas for the differential scattering cross section and for the polarization are derived from the scattering amplitudes, and a completely analytic least-squares method is derived for fitting the theoretical expression to the experimental data. Contributions to the cross section from scattering in the S, P, and D states are included; contributions from tensor and spin-orbit forces are included in addition to those from central forces. The effects of vacuum polarization, of scattering in states of higher angular momentum, and of coupling between states of same J but different L are not computed by inclusion in the scattering amplitudes, but provision has been made to include these effects when calculated separately. The treatment is relativistically correct, but does not include dynamic relativistic effects which are negligible at low energy. Two Fortran-language computer programs are presented; the first makes the least-squares analysis to derive phase shifts from the experimental scattering data; the second evaluates the theoretical expressions for the cross section and polarization for given values of the phase shifts. The estimation of uncertainties in the derived phase shifts is discussed. Author

N65-20540# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE CALCULATION OF LINE STRENGTHS AND SECTION RULES WITH VARIOUS TYPES OF COUPLINGS

Ya. I. Vizbarayte, Z. B. Rudzikas et al 22 Jan. 1965 16 p refs Transl. into ENGLISH from Lit. Fiz. Sb., Akad. Nauk Lit. SSR (Vilna), v. 1, no. 1–2, 1961 p 21–32
(FTD-MT-64-353; AD-612378)

The expressions for matrix elements of some electric multipole operator coupling levels with various types of vector coupling are given. The cases of different types of coupling in the initial and final levels are also considered. Selection rules are established, and expressed by polygonal rules presenting nonvanishing conditions of j-coefficients appearing in expressions of matrix elements of electric multipole operator. Maximum number of sides in these polygons is equal to five. Author

N65-20560# Westinghouse Electric Corp., Pittsburgh, Pa. Westinghouse Research Labs.
MOMENTUM TRANSFER CROSS SECTIONS FOR SLOW ELECTRONS IN He, Ar, Kr, AND Xe FROM TRANSPORT COEFFICIENTS
L. S. Frost and A. V. Phelps 18 Jun. 1964 50 p refs
(Contract Nonr-2584(00); ARPA Order 125-63; Proj. Defender)
(TR-25; AD-442186)

Momentum-transfer cross sections for electrons in He, Ar, Kr, and Xe are obtained for a comparison of theoretical and experimental values of the drift velocities and of the ratio of the diffusion coefficient to the mobility coefficient for electrons in these gases. The theoretical transport coefficients are obtained by calculating accurate electron-energy distribution functions for energies below excitation using an assumed energy-dependent momentum-transfer cross section. The resulting theoretical values are compared with the available experimental data and adjustments made in the assumed cross sections until good agreement is obtained. The final momentum cross section for helium is $5.0 \pm 0.1 \times 10^{-16}$ cm^2 for an electron energy of 5×10^{-3} eV and rises to $6.6 \pm 0.3 \times 10^{-16}$ cm^2 for energies near 1 eV. The cross sections obtained for Ar, Kr, and Xe decrease from 6×10^{-16}, 2.6×10^{-15}, and 10^{-14} cm^2, respectively, at 0.01 eV to minimum values of 1.5×10^{-17} cm^2 at 0.3 eV for Ar, 5×10^{-17} cm^2 at 0.65 eV for Kr, and 1.2×10^{-16} cm^2 at 0.6 eV for Xe. The agreement of the very low-energy results with the effective-range theory of electron scattering is good. Author

N65-20686# Liege Univ. (Belgium).
ACCELERATOR TARGETS DESIGNED FOR THE PRODUCTION OF NEUTRONS
Brussels, EURATOM, Oct. 1964 286 p refs Proc. of the Meeting held at Liège, 17–18 Feb. 1964 Revised English ed.
(Contract EURATOM 050-63-8)
(EUR/C/1137/64e; EUR-1815.e) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 60 Belg. Fr.

Accelerator targets designed for the production of monoenergetic or polyenergetic neutrons were studied. Tritium targets were discussed with a view to their most efficient use, and to the improvements to be made in them in order to increase their life and their yield. Author

N65-20687# India. Dept. of Atomic Energy, Bombay. Health Physics Div.
BUILD-UP OF NUCLIDES IN CYCLIC NUCLEAR OPERATIONS, MATHEMATICAL FORMULATION
P. P. Damle, D. V. Gopinath, and A. K. Ganguly 1964 28 p refs
(AEET/HP/Th-18)

General and exact expressions for the buildup of the nth member of a radioactive chain in cyclic nuclear operations were derived. The expressions take into account the possible modes of depletion of the chain members. Author

N65-20688# India. Dept. of Atomic Energy, Bombay. Health Physics Div.
CHAIN ELEMENT ACTIVITY IN INTERMITTENT IRRADIATION
P. P. Damle and K. Santhanam 1964 20 p ref
(AEET/HP/Th-19)

A method is developed for calculating the activity of neutron induced chain elements or fission products in intermittent irradiation in a reactor. General expressions for the activity of the nth member in such chains were obtained, taking into account the depletion of parent element and daughters by radioactive decay and neutron capture. By regrouping terms, the activity is expressed as a summation of products of a constant times a growth (or decay) term. In going from one cycle of irradiation and decay to the next, the constants remain the same while the growth (or decay) terms alone vary. The concept of an irradiation time equivalent to a cycle of operation and decay is used. The equivalent irradiation time for the first cycle is used as the reference point for the second cycle. First and second cycles can then be represented by an equivalent irradiation time which is used for the third cycle, and so on. By repetition of this procedure, an entire complex irradiation history is simplified. Author

N65-20689# India. Dept. of Atomic Energy, Bombay. Nuclear Physics Div.
ANISOTROPY AND ASYMMETRY IN THE FISSION OF U-235 INDUCED BY 4 MeV NEUTRONS
S. S. Kapoor, D. M. Nadkarni, R. Ramanna, and P. N. Rama Rao 1964 20 p refs
(AEET/NP/9)

The correlation between the angular anisotropy and the mass asymmetry of the fragments was determined in the fission of U^{235} induced by 4-MeV neutrons. The kinetic energies of the pair fragments emitted parallel and perpendicular to the incident beam direction are measured by a three-dimensional analog-to-digital converter incorporated with the print-out arrangement. The anisotropy was found to increase with the asymmetry in the region of mass ratios 1.2 to 1.7. The observed variation of the total kinetic energy E_k and the mean square deviation $\sigma^2_{E_k}$ are found to be different from those observed in the case of thermal fission. The various possibilities leading to the observed dependence of the anisotropy on the asymmetry are discussed. Author

N65-20702# Naval Scientific Technical Information Center, London (England). Research and Development Services Dept.
THE IMPROVEMENT OF INTENSE H. F. SOURCES
J. Depraz Aug. 1964 5 p Transl. into ENGLISH from J. Phys. Radium (Paris), v. 19, 1958 p 86–87
(NSTIC-TRANS-1107; AD-455278)

A high frequency source with maximum ion current containing a high percentage of atomic ions and using reasonably high frequency power for a 300-KeV accelerator is described. The apparatus was used as an intense source of monokinetic neutrons by deuteron–deuteron and deuteron–tritium reactions. Also, a high frequency source of medium output using much reduced high frequency power with a simple oscillator is described. This source was required for more powerful accelerators. Characteristics of the apparatus are included. E.E.B.

N65-20712# Michigan Univ., Ann Arbor. Dept. of Physics
A STUDY OF THE REACTION $p + p \rightarrow d + \pi^+$ FROM 1 TO 2.8 BeV Technical Report No. 18
Richard M. Heinz (Ph.D. Thesis) Oct. 1964 79 p refs
(Contract Nonr-1224(23))
(Rept.-03106-18-T; AD-610076)

The purpose of this investigation was to perform an experimental and theoretical study of the reaction $p + p \rightarrow d + \pi^+$ in the BeV region. The differential and total cross sections for this reaction were measured with scintillation counters for incident proton kinetic energies of 1.0, 1.3, 1.5, 1.7, 2.0, 2.5, and 2.8 BeV, using an external proton beam. A theoretical calculation is made using the one-nucleon exchange peripheral model. Theoretical success is obtained with the one-nucleon exchange model, which qualitatively explains the observed angular distributions of the differential cross section above 1.0 BeV in terms of the strong repulsive core which exists in the nucleon–nucleon central interaction potential; it also shows that the rapid decrease of the total cross section with energy is expected because of the structure of the deuteron momentum space wave function. Author

N65-20715# Argonne National Lab., Ill. Chemistry Div.
THE GENERALIZED RIEMANN ZETA FUNCTIONS AND THEIR APPLICATIONS IN THE CALCULATIONS OF NEUTRON CROSS SECTIONS
M. Atoji and F. L. Clark Dec. 1964 55 p refs
(Contract W-31-109-ENG-38)
(ANL-6970)

The generalized Riemann Zeta function of incomplete mode as defined by the equation

$$\zeta_N^{(s,a)} = \sum_{n=0}^{N} \frac{1}{(a+n)^s},$$

was used in numerical calculations for the case $a > 0$ to establish the tables for the generalized Riemann Zeta function. The computer programs for the calculation were coded in the Fortran language and are presented in tables. The numerical results for the generalized Riemann Zeta function were used to evaluate the unmeasured resonance-level contribution in calculations of the neutron cross section and amplitude. It was found that the analytical form of the neutron resonance is analogous to the formula for anomalous optical dispersion. G.G.

N65-20723# California Univ., Berkeley. Lawrence Radiation Lab.
ANGULAR DISPERSION OF COINCIDENT FISSION-FRAGMENT TRAJECTORIES ARISING FROM A DISK SOURCE
Paul Concus and Rand L. Watson 18 Feb. 1965 18 p
(Contract W-7405-ENG-48)
(UCRL-11965) CFSTI: $1.00

The angular distribution of coincident fission-fragment trajectories arising from a disk source of arbitrary size is derived theoretically, when two disk detectors of equal size are equidistant from and coaxial with the source. Only the geometric effects are considered; the effects of prompt neutron emission are neglected. The angular distribution is found as a closed-form expression in terms of elementary functions, and graphs are given of the distribution for several size-to-spacing ratios of the source and detectors. Author

N65-20779 Joint Publications Research Service, Washington, D. C.
THE INTERFERENCE EFFECT OF NUCLEUS UNDER SHORT RANGE FORCES
Tsung-yeh Chang, Yu-wen Yu, Hsi-ch'uan Chu, Ch'ing-jun Li, and Yu Min *In its* Transl. on Communist China's Sci. and Technol., No. 163 24 Mar. 1965 p 87–103 refs Transl. into ENGLISH from K'o-Hsueh T'ung Pao (Peking), no. 1, Jan. 1965 p 1–7 Presented at the 1964 Peking Sci. Symp.
(See N65-20778 10-34) CFSTI: $4.00

The characteristics of the eigenstates of a two-particle system with δ-force under the L-S coupling approximation are discussed. Based on the interference effect, an approximate method for obtaining the solution was proposed. The approximation was then compared with the rigorous solution and the results found to be very close. Regardless of whether it is for a three-particle or four-particle system, or for a particle–hole system, the eigensolutions with the δ-interaction always exhibit a strong interference effect. Hence the method for approximating the solution is reasonable. E.E.B.

N65-20827# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy).
INJECTION EFFICIENCY IN STORAGE RING [RENDIMENTO DI INIEZIONE IN UN ANELLO DI ACCUMULAZIONE]
L. Mango 19 Feb. 1965 19 p ref In ITALIAN *Its* Nota Interna No. 271
(LNF-65/5)

Two methods of calculating the injection efficiency of the Adone storage ring are described. The first is calculated for a pulsating deflector and the second for a baffle deflector. Trans. by P.F.E.

N65-20836# Los Alamos Scientific Lab., N. Mex.
PION-NUCLEON ELASTIC SCATTERING EXPERIMENTS WITH HIGH INTENSITY MESON BEAMS
Nelson Jarmie 19 Mar. 1965 31 p refs
(Contract W-7405-ENG-36)
(LA-3126-MS) CFSTI: $2.00

Pion–nucleon elastic scattering experiments are studied. Counting rate calculations are made for experiments to measure the pion–proton differential cross section, polarization, and rotation parameters at 300-MeV pion energy. Errors, backgrounds, duty cycles, corrections, and costs are studied in detail. An experiment to measure the pion–neutron interaction is investigated. The results are compared with present research programs and indicate that experiments in elastic pion–nucleon scattering can be done with a high-intensity meson beam cleanly, quickly, economically, and with greatly improved precision. The small size of the beam of the high-intensity source combines with the high intensity to produce notable advantages. Author

N65-20837# Los Alamos Scientific Lab., N. Mex.
BIBLIOGRAPHY OF NUCLEAR INTERACTIONS OF He^3 WITH d, n, OR p AND OF d WITH n, p, OR T AT 3-30 MEV
Betty S. Jackson 5 Mar. 1965 16 p refs
(Contract W-7405-ENG-36)
(LA-3205-MS) CFSTI: $1.00

N65-20841# European Atomic Energy Community, Brussels (Belgium).
STUDIES IN THE FIELD OF HETEROGENEOUS REACTOR THEORY
G. Blaesser, G. Casini, and G. d'Amico (Milan Univ.) Oct. 1964 16 p refs Presented at the Fachtagung des Deut. Atomforums über Reaktortheorie, Karlsruhe (West Germany), 22–24 Apr. 1964
(EUR-2105.e) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 40 Belg. Fr.

In this report are presented main features of the heterogeneous methods for reactor calculations. The application of such methods for the interpretation of substitution experiments is discussed, and first results are given of such an analysis of the substitution measurements performed. Author

N65-20843# European Atomic Energy Community, Brussels (Belgium).
NUMERICAL SOLUTION OF SOME TWO-DIMENSIONAL DIFFUSION NEUTRONICAL PROBLEMS BY THE VARIATIONAL RITZ METHOD [SOLUZIONE NUMERICA DI ALCUNI PROBLEMI BIDIMENSIONALI DELLA DIFFUSIONE NEUTRONICA COL METODO VARIAZIONALE DI RITZ]
I. Galligani Nov. 1964 81 p refs In ITALIAN; ENGLISH Summary
(EUR-2174.i) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 125 Belg. Fr.

The approximate solutions of the homogeneous problem and of the nonhomogeneous problem of the multigroup neutronic diffusion theory may be obtained by searching for the functions which render stationary suitable functionals. These functions are calculated by the Ritz method. Some numerical experiments are given to compare the Ritz method with the finite difference method on two-dimensional diffusion problems. Author

N65-20848# Iowa State Univ. of Science and Technology, Ames. Ames Lab.
NATURE OF THE ENERGY LEVELS IN HYDRATED THULIUM ETHYLSULPHATE
Lewis C. Bartel and Frank H. Spedding Aug. 1964 186 p refs (Contract W-7405-ENG-82)
(IS-968) CFSTI: $5.00

Discussions include the crystal field theory, theory for the effect on the spectra of a magnetic field parallel to the c-axis of a thulium ethylsulfate crystal, and a theory explaining the spectra when the magnetic field is in the basal plane and perpendicular to the light path. The theory for the interaction of the lattice vibrations with the 4f electrons linear in the boson creation and annihilation operators is also discussed. A recent theory of Murao, Spedding, and Good for the even numbered electron rare-earth ions in crystal fields with C_{3h} point group symmetry predicts this: (1) the energies of the lines in the spectra are independent of the angle the transverse magnetic field makes with the a-axis; and (2) some of the line intensities vary as the angle the transverse field makes with the a-axis is varied, but the intensities are a maximum or a minimum at the same angle defining a direction of a new axis. This new axis is the x-axis of a coordinate system in which the lattice sums of the terms proportional to $Y_{6\,6} - Y_{6-6}$ vanish. The theoretical predictions are experimentally verified and the angle between the x-axis and the a-axis is found to be 9° ±2° for a 10% concentration of Tm in Y ethylsulfate. Author

N65-20850# Comitato Nazionale per l'Energia Nucleare. Frascati (Italy).
SHIELDING FOR 400 MeV LINEAR ACCELERATOR AT FRASCATI [SCHERMATURE PER IL LINAC DA 400 MeV DI FRASCATI]
M. Ladu and M. Pelliccioni 18 Feb. 1965 7 p refs In ITALIAN /ts Nota Interna No. 270
(LNF-65/4)

Production and attenuation of gamma and neutron radiation and shielding requirements for the linear accelerator at Frascati are discussed. Gamma radiation and neutron flux, under two operating conditions, were calculated for a position just outside the shielding. Trans. by P.F.E.

N65-20894# AVCO-Everett Research Lab., Everett, Mass.
ELECTRONIC f-NUMBER OF THE N_2^+ (1-) BAND SYSTEM
Kurt L. Wray and Thomas J. Connolly Feb. 1965 9 p refs (Contract DA-19-020-AMC-0210)
(AVCO-Everett Res. Rept.-208; AD-457913)

The electronic f-number of the $N_2^+(1-)$ band system was measured at a wavelength of 4272 Å by monitoring the equilibrium radiation intensity behind (incident) shock heated N_2. Over a temperature range 5690° to 6120° K and initial shock tube pressures of 2.5 to 10 torr, the f-number was found to be 0.0343 ±14%. Author

N65-20942# Atomic Energy of Canada, Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.
THE ENERGY RELEASE IN LOW ENERGY FISSION
J. S. Fraser Feb. 1965 23 p refs
(AECL-2160; SM-60/34) Available from Atomic Energy of Canada, Chalk River: $1.00

The improved precision in the measurements of fragment kinetic energies in thermal neutron and spontaneous fission, made possible by advances in semiconductor and time-of-flight techniques, is discussed. Also, new techniques have revealed a fine structure in the kinetic energy release and mass yields and have led to a reexamination of the so-called energy deficit. This decrease, near symmetric fission, of the total kinetic energy release below that expected from the smooth variation of the Coulomb potential energy of two fragments in contact is also discussed. Further, the variations between the total kinetic energy and the energy of the fission-inducing neutrons are considered. E.E.B.

N65-20943# Atomic Energy of Canada, Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.
THE ENERGIES, ANGULAR DISTRIBUTION, AND YIELDS OF THE PROMPT NEUTRONS FROM INDIVIDUAL FRAGMENTS IN THE THERMAL NEUTRON FISSION OF ^{233}U AND ^{235}U
J. C. D. Milton and J. S. Fraser Feb. 1965 20 p refs
(AECL-2163; SM-60/45) Available from Atomic Energy of Canada, Chalk River: $1.00

The velocity and angular distribution of the neutrons from fission fragments of a given mass and energy were measured. The energies and masses of the fission fragments and the neutrons were defined by a time-of-flight apparatus. About 150000 neutron events obtained from U^{235} are reported. The neutrons were detected in cylinders of NE 102 plastic, 5-inch diameter × 2-inch thick, after traversing a 106-cm flight path. The neutron beam was filtered through 6 inches of bismuth and 8 inches of quartz maintained at liquid nitrogen temperature to give a thermal flux of about 2×10^8 neutrons/cm^2-sec at the position of the source. Under these conditions a thin source of about 40 micrograms/cm^2 of U^{235} gave a coincidence fission rate in the 4-inch detectors of 460 counts/min. E.E.B.

N65-20949# Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf (Austria). Reaktorzentrum
IRRADIATION POSSIBILITIES AND PRODUCTION OF RADIO NUCLEI AT THE REACTOR CENTER SEIBERSDORF [BESTRAHLUNGSMOGLICHKEITEN UND HERSTELLUNG VON RADIONUKLIDEN IM REAKTORZENTRUM SEIBERSDORF]
A. Burtscher and H. Sorantin [1964] 44 p refs
(SGAE-CH-10/1964)

The production of short-lived radio nuclei in an atomic reactor for neutron and gamma radiation is discussed. The construction and experimental instrumentation of the reactor are described in detail, and the various nuclear reactions

to gamma irradiation of antimony^{122}, arsenic^{76} bromine, chromium^{51}, gold^{198}, holmium^{166}, indium^{144}, iridium^{192}, iodine$^{126,130,131, \text{ and } 132}$, potassium^{42}, copper^{64}, lanthanum^{140}, lutetium^{177}, manganese^{56}, and various other elements are presented in a table. Guidelines for packing and transporting the isotopes are outlined. Trans. by G.G.

N65-20952# Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf (Austria). Reaktorzentrum
PHYSICAL AND TECHNICAL ASPECTS OF NUCLEAR PARTICLE ACCELERATORS WITH ULTRA-HIGH ENERGIES [PHYSIKALISCHE UND TECHNISCHE ASPEKTE VON KERNTEILCHENBESCHLEUNIGERN ULTRAHOHER ENERGIEN]
M. J. Higatsberger [1964] 12 p Presented at 10th Metallkunde Kolloquium, St. Christoph am Arlberg, 16 Apr. 1964 (SGAE-G-2/1964)

Different accelerator systems to obtain ultrahigh energies of 3×10^{11} eV and 1×10^{12} (1000 GeV) are discussed, and the accelerator parameters and construction costs for a 1.5×10^{10} eV accelerator are presented. The most important questions center on the production of better magnetic materials and higher vacuum fields as well as the construction of vacuum systems to withstand pressures of 10^{-9} and higher in a pressure chamber of 3- to 4-km diameter. The classes of the various elementary particles are presented in a table, and the basic physics of proton production are discussed. Trans. by G.G.

N65-20972# Bettis Atomic Power Lab., Pittsburgh, Pa.
TIME-DEPENDENT FISSION-PRODUCT THERMAL AND RESONANCE ABSORPTION CROSS SECTIONS (DATA REVISIONS AND CALCULATIONAL EXTENSIONS)
T. R. England Jan. 1965 52 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-33, Addend. No. 1) CFSTI: $3.00

A set of fission-product data for 179 different nuclides and their formation into linear chains consisting of 1 to 17 nuclides is presented. The data include cross sections, half-lives, and direct nuclide yields from the fissile nuclides U^{233}, U^{235}, U^{238}, Pu^{239}, Pu^{241}, and Th^{232}. Extensive tabular and figurative gross absorption cross section and activity results for natural and highly enriched uranium and thorium systems are presented. Use of the new data required no qualitative change in previous conclusions, and there is little quantitative change in results for those reactor fuels and irradiation times already covered. However, new results are presented. In addition, a 12-chain set consisting of 32 nuclides has been abstracted from the total 367-linear nuclide, 69-chain representation. These 32 are found to account for most of the gross poison and its significant spectrum dependence, power dependence, and transient behavior. The reduced representation is found practical for point use in large spatial depletion calculations. Author

N65-21038 Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics
BONDING MECHANISM OF ALKALI-METAL ATOMS ADSORBED ON METAL SURFACES
J. W. Gadzuk *In its* Res. on New Concepts in Energy Conversion 15 Mar. 1965 p 24–30 refs (See N65-21035 10-23)

The mechanism for bonding of cesium upon a cesium surface is reviewed, and recent results from various sources are compared. As an atom approaches a metal surface and is allowed to interact with the metal, the outer electron tends to make a transition into such energetically permissible quantum states as exist in the metal. If there is a perturbation coupling the two states, the transition probability can be predicted. A Sommerfeld metal is considered. The perturbation is taken to be the potential of the ion core as seen by a metal electron. The effective lifetime of an atom before becoming an ion is given by the reciprocal of the transition probability. This finite lifetime of the quantum state gives rise to a natural broadening of the atomic level, because of the uncertainty principle. Using reported values, the equation for lifetime is evaluated as a function of atom distance from the surface. The lifetime and the bandwidth are plotted as a function of distance, and results are compared with those previously reported by others. E.P.V.

N65-21078# European Atomic Energy Community, Brussels (Belgium).
VARIATIONAL KANTOROVICH-RITZ METHOD FOR NUMERICAL SOLUTION OF SOME THREE DIMENSIONAL NEUTRONICAL DIFFUSION PROBLEMS [IL METODO VARIAZIONALE DI KANTOROVICH-RITZ PER RISOLVERE NUMERICAMENTE ALCUNI PROBLEMI TRIDIMENSIONALI DELLA DIFFUSIONE NEUTRONICA]
I. Galligani Nov. 1964 36 p refs In ITALIAN; ENGLISH summary
(EUR-2173.i) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 50 Belg. Fr.

In this report use of the program KANT, which solves the three-dimensional multigroups (up to 20 groups) diffusion equations, is explained. These diffusion equations are solved iteratively by the Gauss–Sidel method. In each energetic group the flux of the reactor is obtained by using a suitable minimum principle of a particular functional. Author

N65-21087# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati
MEASUREMENT OF THE REACTION $\gamma + p \rightarrow p + \pi^0$ NEAR THE FIRST RESONANCE FROM THE POLARIZED PHOTONS OF THE FRASCATI I GeV COHERENT BREMSSTRAHLUNG BEAM
G. Barbiellini, G. Bologna, J. de Wire, G. Diambrini, G. P. Murtas et al 16 Nov. 1964 10 p refs *Its* Nota Interna No. 266 (LNF-64/60)

The ratio of the differential cross sections from photons with polarization perpendicular or parallel to the reaction plane was measured at photon energies of 325 and 228 MeV for the reaction

$$\gamma + p = p + \pi^0$$

The coherent bremsstrahlung from a diamond crystal, which was used for the 325-MeV measurement is shown. The experimental apparatus and procedure are described. For 325 MeV, a ratio of 3.1 ±0.1 was reported. Also, the data for the 228-MeV photons are included. E.E.B.

N65-21102# Comitato Nazionale per l'Energia Nucleare, Fascati (Italy).
TRANSVERSE BEAM SIZE IN ELECTRON STORAGE RINGS
C. Bernardini and C. Pellegrini 5 Nov. 1964 12 p refs *Its* Nota Interna No. 264 (LNF-64/55)

It was shown previously that the transverse area of an electron beam in a storage ring is very sensitive to coupling fields, i.e., to terms in the magnetic field of the machine that can transfer radial into vertical momenta and vice versa. General formulas for extracting the relevant information

from the equations of motion in the presence of coupling fields and radiation are presented. The undamped, unforced, betatron motion is derived from the Lagrangian. The detailed formulas for damping and fluctuation forces are derived. Also, a simple example is used to further investigate these calculations. E.E.B.

N65-21126# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
QUASI-CONSERVED AXIAL CURRENTS, SU_6 SYMMETRY AND THE WEAK AND STRONG COUPLINGS OF PSEUDOSCALAR MESONS
S. Badier and C. Bouchiat Mar. 1965 16 p refs

The physical implications of the two following assumptions are explored: (1) invariance under the SU_6 group generated by the algebra of the weak and electromagnetic current components; and (2) partial conservation of the axial current $J_\mu^{(5)}$ (χ) $(\partial^\mu J_\mu^{(5)}(\chi) = C\phi(\chi))$. A number of predictions concerning the strong couplings of the pseudoscalar mesons to hadrons and the parity conserving amplitudes for nonleptonic hyperon decays are given. Author

N65-21139# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy).
ACTIVITIES AT THE FRASCATI NATIONAL LABORATORY FROM 1 JULY 1963 TO 30 JUNE 1964 [ATTIVITA' DEI LABORATORI NAZIONALI DI FRASCATI DAL 1 LUGLIO 1963 AL 30 GIUGNO 1964]
Dec. 1964 27 p refs In ITALIAN; ENGLISH summary *Its* Notiziario No. 14
(LNF-64/69)

Study and experimentation in fundamental nuclear physics is the principal objective of the laboratories. Particular emphasis is placed upon the field of elementary particles. Most of the experimental work was carried out on the 1100-MeV electron-synchrotron. The design and construction of a large storage ring for colliding beams of electrons and positrons is another important project. The maximum energy shall be 1500 MeV for each beam. This storage ring will lead to the development of a new and important area of research in elementary particles. A linear electron accelerator, having an energy of 450 MeV, which serves as the injector of the storage ring, shall also be used directly in the study of nucleon structure and to create an intense medium energy pion beam. Fundamental research in different fields of physics is encouraged and supported. Research activities include low temperature physics, solid-state physics, electronics, and instrumentation. In connection with the synchrotron and the new projects the laboratories also carry out research in instrumentation and into technical problems. Author

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N65-20149# Princeton Univ., N. J. Plasma Physics Lab.
SCATTERING OF ELECTROMAGNETIC WAVES FROM "MARGINALLY STABLE" ACOUSTIC ION PLASMA WAVES OF A BEAM-PLASMA SYSTEM
V. Arunasalam Dec. 1964 17 p refs
(Contract AT(30-1)-1238)
(MATT-318)

The conditions for the existence of the low-frequency acoustic ion plasma wave instability in beam-plasma systems are discussed. It is shown that when the drift velocity v_d of the beam electrons is in the neighborhood of the phase velocity v_o of the acoustic ion plasma mode, the beam-plasma system exhibits a behavior analogous to that found in phase transitions. The cross sections for the scattering of electromagnetic waves from "marginally stable" acoustic ion plasma waves is shown to exhibit a very large increase in a form somewhat analogous to the critical opalescence for a liquid-gas phase transition. The earlier results of several authors for a current-carrying plasma are recovered by setting the plasma-electron density equal to zero. Author

N65-20191# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Stuttgart (West Germany). Institut für Plasmadynamik
THE PRODUCTION OF HIGH VELOCITY PLASMA JETS BY HEATING AND SELFMAGNETIC ACCELERATION IN ELECTRIC ARCS [ERYEUGUNG HOHER PLASMA GESCHWINDIGKEITEN DURCH HEIZUNG UND EIGEN MAGNETISCHE BESCHLEUNIGUNG IN LICHTBOGEN]
Th. Peters and K. Ragaller (Tech. Hochschule München) Oct. 1964 42 p refs In GERMAN; ENGLISH summary
(DVL-372; DLR-FB-64-28) Munich, ZLDI: 10,30 DM

This report deals with the increase in velocity expected if the arc operates not only inside the arc chamber at nearly constant pressure, but also inside the expansion nozzle. There are two effects which act in the sense of plasma acceleration: (1) During expansion, the plasma is heated by the Joule-heat produced in the arc. (2) In a divergent plasma flow with arc operation, a magnetic acceleration effect develops due to the interaction of current density and selfmagnetic field (Lorents forces). This selfmagnetic acceleration leads to high velocities at high arc current and low gas densities. The experimental observations prove the arc to be stable. Author

N65-20194# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Porz (West Germany). Institut für Energiewandlung und Elektrische Antriebe
CALCULATION OF AN ALTERNATING-CURRENT PLASMA CAPACITOR [BERECHNUNG EINES WECHSELSTROM-PLASMAKONDENSATORS]
B. Tries, S. Kelm, and W. Peschka Dec. 1964 15 p refs In GERMAN; ENGLISH summary
(DVL-346; DLR-FB-64-38) Munich, ZLDI: 4,10 DM

Plasma capacitors use plasma as a dielectric medium. A high magnetic field must also be present perpendicularly to the electric field so that the plasma gets a high dielectricity constant, and the capacitor, a high capacity. Author

N65-20207 Joint Publications Research Service, Washington, D. C.
ON OSCILLATIONS OF MULTIDIMENSIONAL SLIGHTLY NONHOMOGENEOUS PLASMA
Ye. Ye. Lovetskiy and V. P. Silin *In its* Izv. VUZov: Radiophys. Vol. VII, No. 5, 1964 11 Mar. 1965 p 9–16 refs (See N65-20205 10-10) CFSTI: $6.00

The oscillations of slightly nonhomogeneous plasma are studied within the approximation of geometrical optics. Formulas are obtained which describe the spectrum of oscillations of slightly nonhomogeneous plasma in the case where nonhomogeneity is multidimensional for the field equation of arbitrary order. These formulas are used in the analysis of high-frequency oscillations of magnetically active rarefied plasma, quasi-longitudinal oscillations of magnetically active plasma, taking into account spatial scatter, and magnetohydrodynamic waves. Author

N65-20208 Joint Publications Research Service, Washington, D. C.
PLASMA WAVES IN FILMS
Yu. A. Romanov *In its* Izv. VUZov: Radiophys., Vol. VII, No. 5, 1964 11 Mar. 1965 p 17–31 refs (See N65-20205 10-10) CFSTI: $6.00

The plasma energy spectrum in a plasma sheet is analyzed by the kinetic energy method (taking into account delayed interaction) and assuming mirror reflection of electrons at the plasma boundary. The relations derived for the scattering of surface plasma ions differ from the results obtained by Kanazava; reasons for these differences are pointed out. It is shown that in sufficiently thin films there may exist optical plasma waves which, by virtue of strong attenuation, contribute essentially to transient radiation. Author

N65-20209 Joint Publications Research Service, Washington, D. C.
ON THE PROBLEM OF ABSORPTION (RADIATION) OF ELECTROMAGNETIC WAVES BY A CHARGED PARTICLE IN A CONSTANT MAGNETIC FIELD
I. A. Gilinskiy and K. A. Ryazantsev *In its* Izv. VUZov: Radiophys., Vol. VII, No. 5, 1964 11 Mar. 1965 p 32–41 refs (See N65-20205 10-10) CFSTI: $6.00

A quantum analysis is made of electromagnetic waves absorbed (radiated) by a charged particle in a magnetic field. It is shown that in certain cases the frequency spectrum of absorption is equidistant; this circumstance is used to explain the self-resonance mechanism of acceleration. The resonance at higher harmonic frequencies is analyzed by the quantum and the classical theories. Author

N65-20210 Joint Publications Research Service, Washington, D. C.
PLASMA NOISE OF THE HIGH-FREQUENCY DISCHARGE IN A MAGNETIC FIELD
B. N. Shvilkin, M. Ya. Vasil'yeva, and A. A. Zaytsev *In its* Izv. VUZov: Radiophys., Vol. VII, No. 5, 1964 11 Mar. 1965 p 42–47 refs (See N65-20205 10-10) CFSTI: $6.00

Data are presented on the conditions of noise generation in plasma in a magnetic field. Judging by the character of the investigated noises, they may be explained in the light of the ion-acoustic theory and dissipative instability of the nonhomogeneous magnetized plasma. Author

N65-20217 Joint Publications Research Service, Washington, D. C.
RADIATION OF A CURRENT RING IN A WAVEGUIDE
I. N. Ivanov and V. I. Kotov *In its* Izv. VUZov: Radiophys., Vol. VII, No. 5, 1964 11 Mar. 1965 p 116–121 refs (See N65-20205 10-10) CFSTI: $6.00

The article treats the problem of the radiation of a current ring moving uniformly along the axis of a waveguide whose dielectric properties change abruptly at some value of the radius a. Formulas for the radiation power are obtained and analyzed. Author

N65-20227 Joint Publications Research Service, Washington, D. C.
THE TRANSFORMATION OF WAVES ON A PLASMA-DIELECTRIC BOUNDARY
Ts. D. Loladze *In its* Izv. VUZov: Radiophys., Vol. VII, No. 5, 1964 11 Mar. 1965 p 233–236 refs (See N65-20205 10-10) CFSTI: $6.00

In this note the transformation of waves on a plasma-dielectric boundary in an external constant magnetic field is examined. The dependence of the field of radiation on the field of the incident wave is explained. Author

N65-20228 Joint Publications Research Service, Washington, D. C.
SURFACE WAVES IN A GYROTROPIC PLASMA LAYER
I. G. Kondrat'yev *In its* Izv. VUZov: Radiophys., Vol. VII, No. 5, 1964 11 Mar. 1965 p 237–242 refs (See N65-20205 10-10) CFSTI: $6.00

The present work is devoted to electromagnetic surface waves directed by a gyrotropic plasma layer. In essence, it supplements the results of work devoted to surface waves in an isotropic plasma layer and also to surface waves along plasma-vacuum and plasma-metal interfaces in the presence of a transverse (in relation to the direction of propagation) external magnetic field—in the sense of evaluation of the influence of the magnetic field in the first case and of the final thickness of the plasma in the second. There are a number of articles in which surface waves in a plasma layer with a longitudinal magnetic field are examined. Analogous questions are discussed in monographs. Author

N65-20277# Litton Systems, Inc., Beverly Hills, Calif. Space Sciences Labs.
RESEARCH ON ELECTROMAGNETIC PLASMA ACCELERATION Final Report, 15 Dec. 1959–Oct. 1963
A. S. Penfold and R. M. Rosen Jun. 1964 496 p refs *Its* Publ.-3484
(Contract AF 49(638)-759)
(AFOSR-64-1340; AD-609482)

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N65-20278 Litton Systems, Inc., Beverly Hills, Calif. Space Sciences Lab.
PARTICLE MOTION IN AN AXIALLY SYMMETRIC MAGNETIC FIELD
Alan S. Penfold Jun. 1961 *In its* Res. on Electromagnetic Plasma Acceleration Jun. 1964 41 p refs *Its* Publ.-2402 (See N65-20277 10-25)
(TM-61-25)

A description of the motion of charged particles in an electromagnetic field is given. The method can be applied whenever the field possesses a certain type of rotational symmetry about one axis. A cylindrical coordinate system is employed, and the radial, axial, and circumferential motions of a particle are shown to be completely describable in terms of a scalar potential of position and time. The potential also depends on the initial angular momentum of the particle with respect to the axis of symmetry. One of the advantages of the description is that it allows an easy visualization of the primary features of the motion. When applied to a magnetic dipole field, the method is found to yield a potential which is very closely related to one which has already been used by Störmer. The application of the method to the initial phases of the ionization of a tenuous gas is discussed. Author

N65-20279 Litton Systems, Inc., Beverly Hills, Calif. Space Sciences Lab..
A MODEL FOR THE MOTION OF A RAREFIED PLASMA IN AN AXIALLY SYMMETRIC MAGNETIC FIELD
Alan S. Penfold Jun. 1961 *In its* Res. on Electromagnetic Plasma Acceleration Jun. 1964 34 p refs *Its* Publ.-2402A (See N65-20277 10-25)
(TM-27)

Equations of motion are derived for the charged constituents of a tenuous plasma immersed in a time-dependent, axially symmetric, magnetic field. An ion-pair model is employed which assumes strong coulomb forces. The motion of the ion pair is shown to be closely related to that of an isolated positively charged particle whose mass is equal to the geometric mean of the ion and electron masses. Equations for the energy transferred from the field to the ion pair are also derived. Author

N65-20280 Litton Systems, Inc., Beverly Hills, Calif. Space Sciences Lab.
TWO-FLUID MODEL FOR THE MOTION OF A RARIFIED PLASMA ACCELERATED BY INDUCTION
Alan A. Penfold 1 Feb. 1961 *In its* Res. on Electromagnetic Plasma Acceleration Jun. 1964 30 p refs *Its* Publ.-1456 (See N65-20277 10-25)
(TM-10)

A single particle model is considered, assuming the absence of close collisions. The problem is introduced by treating the motion in the absence of Coulomb forces. The Coulomb forces are then assumed to be so powerful that the plasma is macroscopically neutral at all times. The effects of self-fields produced by current flow are neglected at this time. It is shown, however, that these effects are probably large, and an approach to the condition of self-field dominance is demonstrated. The specific axial symmetry is defined for fields in which these results are valid. E.P.V.

N65-20281 Litton Systems, Inc., Beverly Hills, Calif. Space Research Labs.
DETERMINING AXIALLY SYMMETRIC MAGNETIC FIELD PATTERNS
Alan S. Penfold 24 May 1960 *In its* Research on Electromagnetic Plasma Acceleration Jun. 1964 175 p refs *Its* Res. Study 29.14 (See N65-20277 10-25)
(AFOSR-TN-60-842)

A simple method for the determination of some of the properties of a magnetic field is described. The method is applicable provided the field has a certain symmetry about one axis. The required symmetry is not seriously restricting, and many field configurations of practical importance are amenable to this technique. Author

N65-20299# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering
AN INVESTIGATION OF THE WALL-STABILIZED, TRANSPIRATION-COOLED DC ELECTRIC ARC
Ralph N. Jones (M.S. Thesis) Jun. 1964 120 p refs
(GAW/MECH-64-11; AD-610240)

An extension of previous investigations of a wall-stabilized, transpiration-cooled dc electric arc plasma generator was made. Numerical solutions for the energy exchange in the arc were obtained, and an extended theoretical model for the energy exchange was proposed. Measurements of radiative power losses indicated that use of the extended model may be necessary for accurate quantitative analysis, particularly in predicting the radiative losses. Investigation of an unusual spatial electric field strength fluctuation in the arc indicated that experimental error probably did not account for the observation. Spatially nonuniform gas-injection patterns were found to improve the energy-conversion efficiency of the device. Author

N65-20378 Westinghouse Electric Corp., Pittsburgh, Pa. Westinghouse Research Labs.
CONDUCTIVITY PROCESSES AT HIGH DOPING LEVELS
R. R. Heikes *In its* Transport Studies of Defect Struct. Inorg. Compds. [1964] 7 p refs (See N65-20376 10-06)

The transport properties of semiconductors at high doping levels were investigated using the Monte Carlo techniques with a high speed computer. The program required the calculation of electrical conductivity, Seebeck coefficient, and the Hall coefficient as a function of temperature for several concentrations. Encouraging results were obtained for the Seebeck coefficient as a function of temperature. Results of the calculations are presented. Also, it is pointed out that this type of calculation might be of interest to those concerned with impurity band conduction. E.E.B.

N65-20389# Boeing Scientific Research Labs., Seattle, Wash. Plasma Physics Lab.
ENERGY GAIN OF A LOW-ENERGY CHARGED PARTICLE
Richard B. Hall (Centre d'Etudes Nucl. de Saclay (France)) Dec. 1964 23 p refs
(D1-82-0389)

Approximate expressions are derived for the energy gain of a charged particle as a result of either being reflected from or of passing entirely through an rf standing wave. It is shown that energy gain is obtained only when a dc magnetic field is present and commences further from cyclotron resonance as the rf field amplitude increases. The exact equations of motion are numerically solved and curves showing energy gain, ratios of perpendicular to longitudinal energy and the time required for reflection are obtained. It is found that the approximate analysis predicts closely the actual phenomena. Author

N65-20409*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

A STUDY OF ELECTRICAL DISCHARGE IN LOW-PRESSURE AIR

M. Edmund Ellion 1 Apr. 1965 17 p refs

(Contract NAS7-100)

(NASA-CR-57646; JPL-TR-32-678) CFSTI: HC $1.00/MF $0.50

A review was made of the available literature describing the mechanisms of electrical breakdown in gases. The mechanisms suggested by various investigators were then modified or expanded to a form suitable for determining the maximum allowable voltage that can be applied, at any given air pressure, across any gap between conductors in a spacecraft. The final results, giving breakdown voltage as a function of gas pressure for typical gap spacings, are presented in graphical and tabular form. These results indicate that at air pressures of less than 10^{-2} mm Hg electrical discharge will not occur at any voltage. A bibliography of the literature reviewed prior to this study is included. Author

N65-20461# Boeing Scientific Research Labs., Seattle, Wash. Plasma Physics Lab.

RELATIVISTIC MOTION AND ENERGY GAIN OF CHARGED PARTICLES IN A STANDING WAVE NEAR CYCLOTRON RESONANCE

Richard B. Hall Dec. 1964 24 p refs

(D1-82-0388)

The relativistic equations of motion of a charged particle in an rf standing wave and a uniform dc magnetic field are solved by use of a computer. Curves of energy gain, ratios of transverse to longitudinal energy, and interaction times are found for particles that either are reflected from or pass through the rf field. Some of the effects of relativistic mass increase are found to be predicted by a simple modification of the time-averaged theory. It is proved that, after its interaction with an rf field with a space variation only along the dc magnetic field, that the guiding center of the charged particle remains unchanged. Author

N65-20462# Boeing Scientific Research Labs., Seattle, Wash.

PLASMA PHYSICS LABORATORY REVIEW, JULY–DECEMBER 1964

James E. Drummond et al Feb. 1965 26 p refs

The following subjects were studied: *Plasmas in Solids*—fundamental property measurements, shock wave effects, metal–ammonia solutions, plasma heating and acceleration by high-amplitude electromagnetic fields, electron heating, and ion wave instabilities and plasma heating; and *Linear Wave Theory*—magnetoacoustic plasma heating, dispersion relations for hydromagnetic surface waves, two-stream instability in a finite length plasma, universal plasma instabilities and quasi-linear theory, plasma oscillation damping, radio frequency–optical interactions, plasma diffusion and resonance probe studies, and the characteristics of laser interferometers. G.G.

N65-20463# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering

AN EXPERIMENTAL STUDY OF A HOLLOW CATHODE FOR ARC DEVICES

Roland A. Stebbins (M.S. Thesis) Aug. 1964 127 p refs

(GA/ME/64-7; AD-610178)

The voltages, currents, and heat loads to a coiled anode and multielement hollow cathode were determined. The cathode consisted of a flat water-cooled base element and five hollow, water-cooled disks in a vertical column above it. The anodes were water-cooled coils of 1/4-in. diameter copper tubing. When operated in air, the cathode sustained currents of 200 to 300 A before failure. Operation in argon was limited by constrictor failure to about 200 A. Cathode condition was very good after 40 test runs in argon at total currents ranging from 83 to 218 A. Calorimetrically measured heat loads decreased when the current split among the cathode elements and further decreased in an argon atmosphere. Author

N65-20465# Naval Research Lab., Washington, D. C. Applications Research Div.

ELECTRODYNAMICS IN A MAGNETO-IONIC ENVIRONMENT

William R. Faust 12 Nov. 1964 15 p refs

(NRL-6163; AD-610009)

The equations of electromagnetic wave propagation in a magnetoionic environment are first derived via the hydrodynamic equations of motion. This subject is presented to exhibit explicitly the approximations made in obtaining the equations of electrodynamics as applied to a plasma. An application of the above results is then made to derive a generalized equation of reciprocity for a plasma medium. Last a theoretical discussion of the plasma sheath surrounding a satellite shows that the satellite is charged to a potential of about 0.75 V and that the sheath extends out about 2.5 cm. Such a sheath may affect the characteristics of an antenna. Author

N65-20476*# AVCO-Everett Research Lab., Everett, Mass.

ON THE USE OF MAGNETOHYDRODYNAMICS DURING HIGH SPEED RE-ENTRY

P. O. Jarvinen Washington, NASA, Apr. 1965 68 p refs

(Contract NASw-748)

(NASA-CR-206) CFSTI: HC $3.00/MF $0.75

The use of the interaction of a magnetic field with a hypersonic flow, to effect the decelerations and heating encountered during reentry is considered. The equations of motion which describe the reentry history of nonlifting vehicles employing magnetohydrodynamic interactions with the flow field are simplified in the manner of Allen and Eggers. Analytical expressions are derived for the velocity history, deceleration history, and the altitude and magnitude of peak heating and deceleration for reentries involving both low or high magnetic Reynolds number interactions. In both cases it is found that the maximum heating and deceleration experienced can be reduced significantly below that encountered by purely aerodynamic vehicles. Vertical reentries at velocities of 40 000 and 50 000 ft per second are considered. A comparative study of magnetohydrodynamic and aerodynamic vehicles was performed for lifting reentries with lift to drag ratios from 1/2 to 4, typical of manned return from Mars or Venus. Author

N65-20511# Royal Aircraft Establishment, Farnborough (England).

SOME MAGNETO-FLUID-DYNAMIC PROBLEMS INVOLVING ELECTRIC ARCS

W. T. Lord London, Min. of Aviation, Aug. 1963 37 p refs Presented at the 6th Fluid Dyn. Symp. of the Inst. of Basic Tech. Problems, Zakopane, Poland, 2–6 Sep. 1963

(RAE-TN-AERO-2909)

Theoretical problems concerning the columns of electric arcs at high-pressure can be treated on the basis of continuum magnetofluid-dynamics. Proposals made regarding the problems combine physical realism with mathematical simplicity, and relate to the determination of the arc periphery, the forms

of the equations of state and the transport laws, and the representation of radiation from the arc. Specific consideration is given to two cases: the wall-stabilized static arc and the convection-stabilized arc held at rest by an applied transverse magnetic field. In both these cases, if the arc column is long enough it may contain a uniform region in which the voltage gradient is constant. An exact solution for the uniform column of the static arc and an empirical treatment of the uniform column of an arc held at rest are given to indicate some of the features of these arcs. The voltage–current characteristics of both the static arc and the arc held at rest are discussed. Author

N65-20512# Royal Aircraft Establishment, Farnborough (England).
THE INFLUENCE OF GAS STREAMS AND MAGNETIC FIELDS ON ELECTRIC DISCHARGES. PART 2: THE SHAPE OF AN ARC ROTATING ROUND AN ANNULAR GAP
V. W. Adams London, Min. of Aviation, Sep. 1963 38 p refs
(RAE-TN-AERO-2915)

The shape of the column of a dc electric arc rotating in an annular gap between carbon electrodes is derived using a simple model for the arc, based on the concept of a solid conductor with uniform current density in a transverse uniform magnetic field and an opposing uniform flow field. The shape for steady rotation is the involute of a circle, if the electromagnetic and aerodynamic forces are in equilibrium for all points along the arc. This shape is independent of the form of the expressions used for these two forces. The production of a plasma jet from the inner electrode arc root can, however, make the arc column straight for certain conditions. The derived shapes are compared with experimental results, and the simple model is confirmed for large gaps when the electrode effects are small. Author

N65-20603# Princeton Univ., N. J. Plasma Physics Lab.
CESIUM PLASMAS IN A MAGNETIC FIELD WITH VARIABLE CURVATURE
Nicola D'Angelo Nov. 1964 8 p refs
(Contract AT(30-1)-1238)
(MATT-310)

Preliminary results obtained with cesium plasmas produced by surface ionization of cesium atoms in the double-ended operation of a Q-3 device, and confined radially by a magnetic field with variable curvature, are discussed. It was found that low frequency oscillations appear and that the peak density in the plasma column decreases as the radius of curvature of the magnetic lines is decreased from its usual value. A connection between the observed low-frequency oscillations and the plasma losses was not established. G.G.

N65-20628# Boeing Scientific Research Labs., Seattle, Wash. Plasma Physics Lab.
A LOW DENSITY UNIVERSAL INSTABILITY
F. C. Hoh Dec. 1964 20 p refs
(D1-82-0395)

It is shown that an ion acoustic wave in a low-pressure nonuniform plasma propagating almost perpendicular to the external magnetic field is made unstable when finite Debye length is introduced. In connection with this problem, the WKB method, extended to complex potential, as well as the meaning of localized dispersion relations, is considered. It is pointed out that, whereas the localized frequency and growth rate depend upon the slope of the profile, the true values depend sensitively on the curvature of the density profile. Author

N65-20652*# Princeton Univ., N. J. Guggenheim Labs. for the Aerospace Propulsion Sciences
PULSED ELECTROMAGNETIC GAS ACCELERATION Fifth Semiannual Progress Report, 1 Jul.–31 Dec. 1964
Robert G. Jahn and Woldemar F. von Jaskowsky 29 Jan. 1965 71 p refs *Its* Rept.-634d
(Grant NsG-306-63)
(NASA-CR-57570) CFSTI: HC $3.00/MF $0.75

The ejection of the plasma produced in a pinch chamber from an axial orifice in one electrode is studied photographically, and with magnetic probes. The development of the discharge within the chamber is found to be disturbed very little by the presence of the large aperture in one electrode. A luminous front and current sheet are observed to diffract radially and axially outward through the orifice, establishing an exhaust plume which embodies large current densities and magnetic fields. A pulse-line device permitting the application of current waveforms of many shapes to a pinch discharge was constructed and operated. Rectangular current pulses driven through the discharge are found to produce striking improvement in its dynamical characteristics, compared with similar discharges driven by a free-ringing capacitor bank. Results of recent microwave and spectroscopic studies of closed-chamber pinch discharges are found to correlate well with each other, and with previously obtained information on current density and magnetic field distributions. Of particular interest is the identification of a severe rarefaction phase following the first reflection of the primary pinch at the chamber center line which drastically reduces the previously high electron density in the pinch column. Author

N65-20694# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FREQUENCY DISPLACEMENT DURING DIFFUSION OF LIGHT IN RELATIVISTIC PLASMA
O. Pogutse 4 Jan. 1965 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 153, no. 3, 1963 p 578–580
(FTD-TT-64-614/1; AD-610295)

The diffusion of light by an isotropic plasma was investigated by the Maxwellian distribution function without regard to the collective effect in plasma. It was shown that the maximum of diffused light is displaced into the zone of higher frequencies when relativism is considered. The relative frequency displacement in the case of sharp relativism corresponds to the maximum of scattered radiation and is of the order of $1/(1-\beta_T)$. G.G.

N65-20785# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
INVESTIGATIONS OF GROWING WAVES EXCITED IN A PLASMA BY AN ELECTRON STREAM
John R. Apel and Albert M. Stone Dec. 1964 20 p Presented at the 6th Ann. Meeting, Div. of Plasma Phys., Am. Phys. Soc., New York, 4–7 Nov. 1964
(Contract NOw-62-0604-C)
(TG-636; CPR-043; AD-610183)

An experiment was constructed for the study of waves excited in a plasma by an electron stream. A PIG source generates a hydrogen plasma of density up to $10^{13}/cm^3$ and 30 eV electron temperature, confined by a 500-gauss field. A 40-mA, 1000-volt electron beam is pulsed into the plasma. Coherent, growing waves are excited at frequencies typically near 500 Mc when the plasma frequency is 1800 Mc and the cyclotron frequency 900 Mc. The wave grows in both space and time until it reaches a limiting amplitude, after which it decays; this entire process repeats at about a 40-Mc repetition rate at a power

level of several watts. Diagnostic equipment includes a 3000-Mc oscilloscope, a spectrum analyzer, and various probes. If the dispersion equation governing the waves is solved for the finite geometry of the experiment, it becomes apparent that the growth occurs because of the interaction between the slow plasma wave on the electron beam and the electron cyclotron wave in the plasma. Author

N65-20821 California Univ., Santa Barbara. Physics Dept.
THE BRUSH CATHODE PLASMA IN HYDROGEN
G. A. Woolsey *In its* Quant. Studies by Opt. Spectry. of Energy Exchange Mech. in Simple Gases and Solids 1 Jan. 1965 p 18–22 refs (See N65-20817 10-23)

The discharge in hydrogen at pressures near 1 mm Hg, obtained using a brush cathode, appears similar to that in helium. It consists of a narrow relatively dark region adjacent to the cathode, together with a negative glow that extends beyond a ring anode. Stark effect measurements of the electric field in the dark region show almost the entire tube voltage (~2kV) to be across this space. Consequently, a uniform electron beam is generated with energy of the order of 2 keV, which accounts for the negative glow extending one or two orders of magnitude further than that in a normal glow discharge. Probe measurements, together with the fact that it is field free, show the negative glow to be a plasma. Attempts to measure charge-carrier concentrations spectroscopically have so far been unsuccessful, due to the low positive ion densities ($\sim 10^{10}$ cm^{-3}) in the plasma. Author

N65-20907# Maryland Univ., College Park. Center for Atmospheric and Space Physics
OFFSET VOLTAGES OF LANGMUIR PROBES IN THE IONOSPHERE Scientific Report No. 3, Jan.–Oct. 1964
Richard T. Bettinger Oct. 1964 19 p refs
(Contract AF 19(628)-2792)
(AFCRL-65-54; AD-613065)

Bipolar Langmuir probes display a voltage offset in their volt–ampere characteristics when immersed in the ionospheric plasma. The dependence of the equilibrium potential as a function of probe scale, ambient charge density, and high energy tail in the electron energy distribution is examined. Conclusions are that the offset arises from geometric considerations and is strongly influenced by all of the above factors. The observed altitude dependence is qualitatively explained in terms of vehicle velocity and precessional motion. Author.

N65-20933# ARO, Inc., Arnold Air Force Station, Tenn.
SOME CHARACTERISTICS OF AN ELECTRICAL DISCHARGE TRANSVERSE TO A SUPERSONIC SEEDED NITROGEN PLASMA STREAM WITH COLD-COPPER ELECTRODES
K. E. Tempelmeyer, J. M. Whoric, L. E. Rittenhouse, and M. L. Mc Kee Arnold Eng. Develop. Center, Mar. 1965 72 p refs
(Contract AF 40(600)-1000)
(AEDC-TR-65-52; AD-459312)

The discharge from cold-copper electrodes had an overall voltage-current characteristic which was positive in all cases. The effects of (1) the type of seed (K_2CO_3 or NaK), (2) the seeding rate (about 0.2% to 2% K or NaK by weight), (3) the static pressure level (from 0.3 to 1.0 atm), and (4) the plasma enthalpy level (from about 1250 to 1800 kcal/kg) on the discharge are given in figure form. Dynamic data were also recorded, and demonstrate that rather large fluctuations having frequencies of a few hundred cps exist in the current. It is proposed that the electrodes introduce electrons into the conducting plasma through field emission. The discharge appears diffuse in the core of the plasma and may be quantitatively explained with an existing nonequilibrium, elevated-electron temperature theory. Author

N65-21013# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COMPUTATION OF THE PARAMETERS OF THE LOW-PRESSURE PLASMA IN NEON
N. V. Basova, A. M. Devyatov, G. S. Solntsev, and P. I. Skvortsov 2 Feb. 1965 10 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. III, Fiz.-Astron. (Moscow), no. 2, 1963 p 37–42
(FTD-TT-64-838/1+2; AD-611015)

On the basis of the theory of B. N. Klyarfel'd there were computed the values of T_e, E_z, and N_i in a discharge with an incandescent cathode in neon with pressures of 0.02 to 0.2 mm of Hg column, taking into account the losses in energy through radiation. Comparison of the results of the computations with the results of the probe measurements shows satisfactory agreement between them. Author

N65-21036 Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics
MAGNETOHYDRODYNAMIC INDUCTION MACHINE WITH LAMINAR FLUID FLOW
E. S. Pierson and W. D. Jackson *In its* Res. on New Concepts in Energy Conversion 15 Mar. 1965 p 4–17 refs (See N65-21035 10-33)

An exact consideration of velocity profile effects is impossible but a solution for laminar flow has been obtained providing insight into the mutual interaction of power density and viscous losses. The techniques developed for solving approximate equations can be combined to obtain an exact solution for laminar flow by iteration. The electromagnetic field for a constant fluid velocity is used as the starting point and the normalized approximate equations are solved repetitively for the new velocity and field in that order, until the solution converges to the desired accuracy. The convergence is good for small magnetic Reynolds numbers (R_M), but becomes worse as R_M increases because the fluid profile has more effect on the field. The exact solution has been obtained for several sets of parameters, and can be extended to others if desired. The slit-channel results have been used to obtain predicted performance characteristics given in another report. E.P.V.

N65-21046# Air Force Cambridge Research Labs., Bedford, Mass. Microwave Physics Lab.
PLANE WAVE PROPAGATION IN A NONLINEAR, INHOMOGENEOUS, TIME-DEPENDENT PLASMA MEDIUM
R. J. Papa Jan. 1965 46 p refs *Its* Phys. Sci. Res. Papers No. 76
(AFCRL-65-51; AD-612692)

Numerical solutions to the energy balance equation and continuity equation were obtained for the electron gas representing the nonlinear interaction of a radiofrequency plane wave with a time-varying and spatially varying electron density profile. Graphs are presented depicting the time-dependent response of the electron density and electron temperature when the inhomogeneous plasma is subjected to a monochromatic, radiofrequency plane wave. Also, the nonlinear interaction of a radiofrequency plane wave with a time-varying plasma medium is extended to the anisotropic case. An elliptically polarized plane wave incident upon an electron density profile

induces changes in the electron temperature and electron density. A dc magnetic field parallel to the electron density gradients causes the elliptically polarized wave to split into a right circularly polarized and a left circularly polarized mode. The two modes are coupled through an energy balance equation for the electron gas that governs the electron temperature. The time-dependent response of the plasma is found by numerically integrating an energy balance equation and a continuity equation. The wave field in the time-dependent, anisotropic medium is expressed as a superposition of a right and left circularly polarized mode. Author

N65-21142# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France).
STUDY OF BEAM-PLASMA INTERACTIONS IN THE PRESENCE OF A MAGNETIC FIELD [ETUDES D'INTERACTIONS FAISCEAU-PLASMA EN LA PRESENCE DU CHAMP MAGNETIQUE]
Claude Etievant (Ph.D. Thesis—Paris Univ., 1963) Brussels, EURATOM, Dec. 1964 233 p refs In FRENCH; ENGLISH summary
(Contract EURATOM-007-62-1 FUAF)
(CEA-R-2456; EUR-1808.f) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 280 Belg. Fr.

The instabilities developing in a beam-plasma system and in a double-beam system in the presence of a magnetic field are discussed theoretically starting from the conductivity tensor expression for a multibeam system. Oblique propagation is taken into account and this leads to the introduction of certain instability mechanisms which would not appear in the case of a propagation which is purely parallel or perpendicular to the magnetic field. Two experiments are described: study of the collision of two counterstreaming electron beams, and of a "beam-plasma" system. This perturbation is very pronounced when plasma–plasma interaction appears in the system. A study into cyclotron oscillations produced in the plasma by excitation due to the passage of the beam is also described in this report. Author

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N65-20239# Franklin Inst., Philadelphia, Pa. Labs. for Research and Development
A STUDY OF SURFACE PHENOMENA ON ORGANIC SOLIDS Quarterly Progress Report, 10 Sep.–9 Dec. 1964
P. J. Reucroft, P. Chairge, and M. M. Labes 11 Dec. 1964 12 p ref
(Contract DA-18-035-AMC-141(A))
(QPR-2; AD-609965)

The background adsorption of the volumetric system was carefully evaluated as a preliminary to adsorption studies on organic solid powders. Background adsorption on the glass walls was reduced to a low value by coating the surface with silicone fluid. The adsorption of krypton and ammonia under these conditions was then determined in order to establish correction factors. Author

N65-20244# Lincoln Lab., Mass. Inst. of Tech., Lexington.
SPIN-WAVE EFFECTS IN THE MAGNETIZATION REVERSAL OF A THIN FERROMAGNETIC FILM
K. J. Harte 27 Aug. 1964 91 p refs
(Contract AF 19(628)-500)
(TR-364; ESD-TDR-64-366; AD-610068)

The influence of spin waves on rapid rotational magnetization reversal (switching) in a thin ferromagnetic film is investigated by means of a semiclassical, continuum theory which includes external, anisotropy, exchange, and magnetostatic (dipolar) fields. To simplify the magnetostatic field, a thin-film approximation is introduced, in which the magnetization is replaced by its average over the film thickness. A brief discussion is given of the uniform rotational switching mode (without spin waves), with particular attention to undamped and overdamped cases. From the spin-wave equations of motion, the spectrum applicable to a parallel resonance situation (external field in the film plane) is first obtained, and long-wavelength magnetostatic distortion noted. Author

N65-20305# General Electric Co., Schenectady, N. Y. Research Lab.
THE HARDENING OF LITHIUM FLUORIDE CRYSTALS BY IRRADIATION
J. S. Nadeau and W. G. Johnston Jun. 1961 12 p refs
(Rept.-61-RL-2766M)

The very soft, pure crystals of LiF commercially available are unsuitable for some experimental work because they suffer accidental plastic deformation during cleavage, and tend to split. Irradiation with gamma rays produces harder crystals that can be cleaved and handled without much damage. The radiation-induced hardening and the color centers produced by moderate irradiation can be completely removed by annealing for several hours at 450° C. This method for handling very soft crystals may be useful for other types of crystals, and various types of irradiation can be employed. Author

N65-20306# Office of Aerospace Research, Washington, D. C. Historical Div.
CADMIUM SULFIDE—A HISTORY OF SEMICONDUCTOR RESEARCH AT THE AEROSPACE RESEARCH LABORATORIES
Nick A. Komons [1964] 82 p refs
(OAR-64-11; AD-455519) GPO: $0.40

An historical account is given of the laboratory's program in Group II-VI compound semiconductors from the beginning of the program in 1951 to the present. Studies relating to the electrical and optical properties of cadmium sulfide are emphasized. Author

N65-20309# Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf (Austria). Reaktorzentrum Seibersdorf
ELECTRONMICROSCOPIC THICKNESS DETERMINATION OF THIN MONOCRYSTAL PLATES [ELEKTRONENMIKROSKOPISCHE DICKENBESTIMMUNG DUNNER EINKRISTALLAMELLEN]
E. M. Hörl 1964 17 p refs In GERMAN Submitted for Publication
(SGAE-M-2/1964)

A method for measuring the thickness of very small and thin monocrystal flakes utilizes the parameter distance dependency in the vicinity of the reciprocal grid points from the thickness of the crystal flake. This makes it possible to determine the absolute thickness as well as the relative measurements of the crystal steps. Trans. by G.G.

N65-20443# Naval Scientific Technical Information Center, London (England). Research and Development Services Dept.
QUENCHING OF METALS IN LIQUID HELIUM II—A NEW METHOD
L. Rinderer and H. Schultz Oct. 1964 4 p refs Transl. into ENGLISH from Phys. Letters (Germany), v. 8, no. 1, Jan. 1964 (NSTIC-TRANS-1618; AD-455288)

A new method for freezing in lattice defects, which are formed in thermal equilibrium at high temperatures, involves quenching the base metal in a liquid helium II bath. This process increases quenching velocity, quenches to 1.5° K, provides a direct determination of the frozen-in defects, avoids gaseous impurity absorption, and is applicable to metals with high melting points. R.N.A.

N65-20518# Army Electronics Labs. Fort Monmouth, N. J. Solid State and Frequency Control Div.
"SOLDER BALL" FORMATION IN SILICON ALLOY TRANSISTORS
E. B. Hakim, L. K. Mc Sherry, and B. Reich Jan. 1965 19 p refs
(ECOM-2555; AD-612063)

The investigation and solution of the so-called "solder ball" problem which has plagued the transistor industry for years are discussed. Upon investigating silicon alloy transistors which use tin for electrodes, it was discovered that "solder balls" (which can cause internal short circuiting of the device) are not necessarily associated with manufacturing procedures as previously believed, but are produced by the devices themselves because of the material used in construction. Electrical stresses or high temperatures produce balls in units which initially were free of any foreign matter. This is due to the low melting temperature tin alloy used in the transistor's (or other semiconductors) construction. Thus, devices may have balls when put in use and later cause equipment failure. The devices appear good under all measurements. However, when the device is in use, a mechanical shock may shake a ball loose, shorting the transistor and making the circuit inoperable. Author

N65-20522# Stanford Research Inst., Menlo Park, Calif.
THIN-FILM COLD CATHODES FOR MICROWAVE TUBES
D. V. Geppert and B. V. Dore Oct. 1964 43 p refs
(Contract AF 33(615)-1345)
(IR-3; AD-607915)

Sintered ZnO layers were investigated using both cold-press and hot-press techniques. Ohmic contacts between platinum substrates and the ZnO layers were studied. The problem of obtaining blocking contacts between the ZnO and evaporated surface films was studied, and barriers up to 2.7 eV can now be obtained. Evaporated BaO was investigated as an activator for the surface films. Photoelectric work functions down to 1.75 eV have already been measured, and it is believed possible to reduce the work function down to about 1 eV by this technique. Life tests on ZnO diodes indicate no significant change in characteristics after almost 1000 hours of operation. Author

N65-20549# Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy
RADIAL DISTRIBUTION FUNCTIONS IN SOLID COBALT Technical Report No. 9
Rune Gunnar Lagneborg and Roy Kaplow 23 Dec. 1964 48 p refs
(Contract Nonr-1841(35))
(DSR-7618)

Radial distribution functions were calculated from X-ray diffraction data by means of digital computer programs for Co-α and Co-β near the allotropic transformation temperature. These functions provide values of lattice parameters, mean square amplitudes of vibration, vibrational coupling factors, and the mean force potential function. The mean square amplitude of vibration $\overline{u_s^2}$ for α and β at 417° C are 0.0155 and 0.0168 $Å^2$, which correspond to Debye temperatures of 332° and 320° K, respectively. The Debye temperature and coupling factors obtained for β at 417° C were consistent with a second experimental distribution function determined at 678° C, indicating that those parameters are essentially invariant over that range of temperature. From the mean force potential functions the elastic moduli for nearest neighbor directions have been determined. Pertinent thermodynamic values may be derived from the X-ray results. Author

N65-20554# Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
ACTIVE ACOUSTIC DEVICES Technical Report, 17 Jun.–30 Sep. 1964
W. H. Brendecke Griffiss AFB, N.Y., RADC, Feb. 1965 29 p refs
(Contract AF 30(602)-3478)
(RADC-TR-64-517; AD-612703)

Investigations of the six major transducer types were initiated to determine the feasibility of using each type in continuous wave devices. The most promising is the thin-film transducer due to the close control of geometric factors. Exact control over placement, size, and thickness can be achieved through selective masking and process deposition rates. Mechanical polishing limits the bonded quartz transducer to a maximum frequency of 175 Mc/sec. Compensated region transducers with 2- to 3-dB loss have been constructed between 10 and 30 Mc/sec. The difficult growth process will limit epitaxial transducers to very preliminary experiments. Depletion layer transducers will be eliminated from further investigations due to the inability of II-VI compounds to form p-n junctions. Author

N65-20574# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE WORK OF THE ELECTRONIC PHYSICS DEPARTMENT AT THE WARSAW POLYTECHNIC INSTITUTE
Witold Majewski 11 Jan. 1965 13 p refs Transl. into ENGLISH from Postepy Fizyki (Poland), v. 14, no. 6, 1963 p 659–665 (FTD-64-926/1+2+3+4; AD-455516)

Temperature curves for the dielectric losses (alternating current measurements) and for the ohmic resistance (direct current measurement) were made for certain aromatic organic compounds. Anthracene, hexanitroazobenzene, and aminonapthalene resin with nitroaminonaphthalene resin were included in the first group. Mixtures of polystyrene with resins and mechanical mixtures of resins were included in the second group. Also, the properties of the metal–dielectric point contact were investigated. The experiments were carried out at a voltage of 1.2 volts on layers about 1-micron thick. It was observed that the current–voltage curves for the dielectrics were symmetrical for both directions of the current. In contrast to this, the current–voltage curves for semiconductors were asymmetrical. E.E.B.

N65-20601# Bell Telephone Labs., Inc., New York.
FERRIMAGNETIC MATERIALS AT MICROWAVE FREQUENCIES

A. S. Boxer, H. L. Goldstein, H. E. Noffke, and J. F. Ollom Jul. 1964 52 p refs
(Contract AF 33(657)-8439)
(ML-TDR-64-224; AD-459423)

A review was made of existing theories on large-signal behavior of ferrites. The effect of frequency modulation on high-power instability was studied. Frequency modulation raises the threshold power for nonlinear breakdown; the optimum modulating frequency is related to the spin-wave line width. An experimental study was made of relaxation oscillations occurring in single-crystal yttrium iron garnet excited above the threshold of nonlinearity in a resonant cavity. Stable oscillations occur only at power levels close to the threshold. From observation of frequency and amplitude under different operating conditions, it was concluded that these oscillations are intrinsic to the sample and do not depend on cavity parameters. Instrumentation was developed to measure complex permittivity at X-band and resonance line width and spin-wave line width at both X- and K_u-bands. Measurements on selected samples showed that high spin-wave line width, required for high-power operation, is generally connected with high resonance line width. In most cases, line widths at K_u-band are higher than those at X-band. No correlation was found between dielectric and magnetic losses. Author

N65-20767# India. Dept. of Atomic Energy, Bombay. Chemistry Div.
STUDIES OF THE ELECTRICAL PROPERTIES OF URANIUM OXIDES. III: ROOM TEMPERATURE MEASUREMENTS OF THE HALL COEFFICIENTS OF α AND Δ-U_3O_8
Nirmal Singh and M. D. Karkhanavala 1964 8 p refs
(AEET/CD/27)

Hall coefficient measurements at room temperature on sintered specimens of alpha-U_3O_8 and delta-U_3O_8 are reported. The effective number of conduction electrons are calculated to be $1.3 \times 10^{14} cm^{-3}$ and $5 \times 10^{14} cm^{-3}$, while the Hall mobility was found to be 0.79 cm^2 $volt^{-1}$ sec^{-1} and 0.49 cm^2 $volt^{-1}$ sec^{-1}, respectively, for alpha- and delta-U_3O_8. Author

N65-20775# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research
NEUTRON DIFFRACTION STUDY OF THE MnHg ALLOY
Andrzej Oleś Nov. 1964 20 p refs
(Rept.-559/VI)

Neutron diffraction patterns were obtained at temperatures of 4.2° K and 300° K for the MnHg alloy. The results show that the antiferromagnetic arrangement of the magnetic moments exists even at room temperature. The Néel point was established at 460° K by both the neutron method and the measurement of the magnetic susceptibility. The magnetic moment of the manganese atom was found to be $\mu = (3.7 \pm 0.2)\mu_b$. It was found by means of the neutron method that there is a change of the direction of easy magnetization at 198° K. Author

N65-20780 Joint Publications Research Service, Washington, D. C.
STIMULATED EMISSION FROM GaAs P-N JUNCTIONS
Wu-lin Liu *In its* Transl. on Communist China's Sci. and Technol., No. 163 24 Mar. 1965 p 104–110 ref Transl. into ENGLISH from K'o-hsueh T'ung Pao (Peking), no. 1, Jan. 1965 p 65–67 (See N65-20778 10-34) CFSTI: $4.00

The characteristics of a GaAs laser capable of producing stimulated emission are discussed. The narrowing of spectral lines, decrease of the light bundle angle, and the sudden increase of the radiation intensity as the current is increased through the threshold value were considered. The variation of the threshold current at 77° and at 20° K was also studied. The p-n junctions were prepared by the diffusion method. The Zn was made to diffuse into n-type GaAs, in which the initial Te impurity density varied from 5×10^{17} per cc to 1.5×10^{18} per cc. The diffusion length was approximately 5 mm. Threshold currents in the range of 2600 to 6000 amp/cm^2 were obtained for different specimens of the p-n junctions. E.E.B.

N65-20822 California Univ., Santa Barbara. Physics Dept.
VELOCITY OF SOUND IN VAN DER WAALS CRYSTALS
S. L. Shapiro *In its* Quant. Studies by Opt. Spectry. of Energy Exchange Mech. in Simple Gases and Solids 1 Jan. 1965 p 23–24 (See N65-20817 10-23)

Preliminary experiments investigating Brillouin scattering in selected materials are in progress. The main goal is the detection of Brillouin scattering in the simple molecular crystals of N_2, O_2, and argon in order to learn more about van der Waals' crystals. Although measurements on the elastic properties of polycrystalline argon were carried out by the ultrasonic method, crystals grown by the modified Bridgman technique have never been analyzed for elastic constants. Author

N65-20823 California Univ., Santa Barbara. Physics Dept.
FREE CARRIER MOBILITY IN SOLID AND LIQUID RARE GASES
H. D. Pruett *In its* Quant. Studies by Opt. Spectry. of Energy Exchange Mech. in Simple Gases and Solids 1 Jan. 1965 p 25–27 refs (See N65-20817 10-23)

After several unsuccessful attempts, optical excitation methods for generating free carriers in solid and liquid argon, were abandoned in favor of the original alpha particle induced excitation method. New equipment constructed includes a temperature control system using liquid oxygen refrigerant and an automatic pressure regulator, as well as an oil diffusion pump system for evacuation of the rare gas crystal-growth cell to a pressure of about 10^{-6} mm. Electrode spacings smaller than 1.0 mm cause the introduction of part of the power supply ripple onto the desired signal. A high voltage ripple filter was constructed to eliminate this problem. Conductivity pulses have now been observed in both liquid and solid argon. E.P.V.

N65-20826# Westinghouse Electric Corp., Pittsburgh, Pa.
GROWTH AND CHARACTERIZATION OF SINGLE CRYSTALS OF RARE EARTH COMPOUNDS Quarterly Technical Report
[1964] 10 p refs
(Contract AF 49(638)-1245)
(QTR-6; AD-610361)

Large single crystals of EuS were grown from the melt, and hemispherical crystals of Si-doped $CrBr_3$ were epitaxially grown on CaF_2 single crystal substrates. These were typically susceptible to cleavage fracture, causing difficulty in electrical measurements. Resistance data for two thin-film samples of La-doped EuS showed a temperature as high as 50° K for which the sharp peak occurs in the curve

$$\log \frac{\rho}{T} \text{ vs } 1/T$$

The effect of impurity scattering on the electrical resistivity of Gd was studied for the solute elements of La and other rare

earths. All dilute binary alloys of Gd containing the chosen solutes have higher resistivities than pure Gd, but the differences gradually diminish as the temperature approaches the Curie point, almost disappearing at higher temperatures. A strong spin dependence of residual resistivity is indicated for these alloys. This spin-dependent scattering effect of impurities is compared with the intrinsic spin disorder resistance of Gd. The study of CrTe–CrSb magnetic structures was confined to the CrTe-rich solutions. E.P.V.

N65-20851# India. Dept. of Atomic Energy, Bombay. Chemistry Div.
STUDIES OF THE ELECTRICAL PROPERTIES OF URANIUM OXIDES. IV: NON-STOICHIOMETRIC U_3O_8
Nirmal Singh and M. D. Karkhanavala 1964 33 p refs
(AEET/CD/33)

The dc electrical conductivity (σ) and the Hall coefficient (R_H) have been measured in the range 250° to 400° K on pellets of U_3O_8 sintered for different periods (up to 120 hours) at 900° C, resulting in a variation of the O/U ratio from 2.666 to 2.63 and an increase in the density from a green density of 5.62 to 8.08 g/cm^3. The values of the electrical conductivity were corrected for porosity. With increase in the time of sintering, the conductivity and Hall mobility increased, while the activation energy of conduction decreased. The results on the highly sintered (96.5% theoretical density) pellet of composition $UO_{2.63}$ have been interpreted on the basis of hopping of small polarons. Author

N65-20889# Airtron, Inc., Morris Plains, N. J. Advanced Devices Lab.
DEVELOPMENT OF A FERRITE MATERIAL FOR A HIGH POWER PHASE SHIFTER AT S-BAND Final Report, 18 Apr. 1962–15 Jan. 1964
E. Anderson, A. Bates, D. Blake, R. Blank, J. Borshard et al [1964] 123 p refs
(Contract NObsr-87388)
(RH-439; AD-433657)

Data obtained on gallium and aluminum substituted nickel ferrite are presented. The material which seemed most capable for use in a phase shifter had a total aluminum plus gallium substitution of 0.975 moles. The composition was $Ni_{.98}Mn_{.02}Ga_{.301}Al_{.674}Fe_{1.025}O_4$. This material had a Curie temperature of 200° C, a 20 Mc tan δ of approximately 0.003, a saturation magnetization of approximately 970 gauss, and a χ'' at resonance of approximately 4.0 at 930 gauss. The χ'' minimum was 0.05. This material when hot pressed did not show any decrease in relative susceptibility at power levels as high as 2000 kW, whereas magnesium manganese ferrite showed nonlinear effects at a power level of 20 kW. Although this material had the above properties when a 6 in. × .900 in. × 900 in. bar was placed in a Reggia–Spencer phase shifter, it exhibited high loss. A usable Reggia–Spencer phase shifter with this material was not built; however, this material should prove useful in nonreciprocal devices, such as circulators and isolators. Author

N65-20890# Airtron, Inc., Morris Plains, N. J.
GROWTH OF BROAD LINEWIDTH RUBY CRYSTALS Semi-annual Technical Summary Report, 1 Jul.–31 Dec. 1963
[1963] 42 p ref
(Contract Nonr-3832(00); ARPA Order 306; Proj. Defender)
(R11-442; AD-432341)

Progress was achieved in perfecting techniques for the growth of ruby from PbF_2 fluxes. By lowering the pedestal supporting an 8 in. × 8 in. crucible until a 200° C temperature difference is measured between the pedestal and the furnace plug, mounted above the crucible, and slowly cooling at the rate of 1.5° C per hour, with good temperature control, large ruby plates up to 3/8 in. thick and 2 in. in maximum dimension were grown. Solubility of dilute ruby in PbF_2 was measured by heating Al_2O_3 and Cr_2O_3 in PbF_2, slowly cooling the melt to a specified temperature, decanting and quenching the melt in a water cooled platinum crucible, and determining the remaining Al_2O_3 by wet chemical analysis. This work shows a solubility of dilute ruby at 1000° C of 21.8 mole% and 1200° C of 23.9 mole%. The Cr^{3+} content was about 0.02 mole%. A rod, 1.172 in. long × 0.213 in. diameter, cut from a ruby plate, was silvered and polished. It lased at 1200 joules at 200° K in a 3 in. long laser head. Experiments on growth of ruby on ruby seeds were made with only limited success so far. Additional experiments are being made in order to improve the amount of growth made on the ruby seeds. Author

N65-20902# Westinghouse Electric Corp., Pittsburgh, Pa. Westinghouse Research Labs.
DEPOSITION OF SILICON ON INSULATING SUBSTRATES Scientific Report No. 1, 1 Jul.–31 Dec. 1964
T. L. Chu, G. A. Gruber, J. J. Oberly, and R. L. Tallman 22 Jan. 1965 62 p refs
(Contract AF 19(628)-4220)
(AFCRL-65-52; AD-458662)

The pyrolysis of silane and the vacuum evaporation of silicon were used for the deposition of silicon films on various substrates. Silicon films up to 60μ thick were deposited on {111} oriented silicon, {001} oriented sapphire, and {001} oriented hexagonal silicon carbide substrates by the pyrolysis of silane in a flow system using hydrogen as a diluent. Silicon films deposited on silicon substrates were of good crystal perfection. Silicon films deposited on sapphire and silicon carbide substrates were epitaxial with respect to the substrates and of predominantely {111} orientation. Apparatus and procedures of the deposition processes and the evaluation of the silicon films are discussed. Exploration of new substrate materials was carried out. Thorium dioxide films were deposited epitaxially on {111} oriented silicon and fluorite substrates by vacuum evaporation. Silicon nitride films were deposited on silicon substrate by nitridation, vacuum evaporation and reactive sputtering. The deposition processes and the properties of these films are discussed. Author

N65-20904# Arizona State Univ., Tempe.
OXIDE SEMICONDUCTOR MATERIALS AND DEVICE RESEARCH Final Report, 18 Jan. 1962–17 Nov. 1964
F. L. English, C. J. Kevane, J. J. Morrison, B. M. Warmkessel, and H. B. Whitehurst [1964] 89 p refs
(Contract DA-36-039-SC-89151)
(Rept.-12; AD-458541)

A study of the electrical properties of semiconducting ceramic rutile is reported, and the mechanism of rectification observed in some of the devices prepared from the material discussed. Methods of preparing the semiconducting ceramic are also presented. Main effort was expended on preparation and measurement of ceramics made from pure titanium oxide, or from titanium oxide with small amounts of other cations added. A method of preparing the ceramic by the slow dehydration of precipitated titanium dioxide was developed. It was concluded that the rectifying diodes formed from semiconducting ceramic rutile may have limited use at room temperature due to the rather high forward resistance observed to result from the use of insulating layers thick enough to provide adequate reverse breakdown voltages. Author

N65-20918# Princeton Univ., N. J. Solid State Electronics Lab.
ELECTRONIC PROPERTIES OF ORGANIC SEMICONDUCTORS Quarterly Technical Report
George Warfield, Mehmet Rona, and Roger Westgate [1964] 7 p
(Contract DA-31-124-ARO(D)-191; ARPA Order 462)
(QTR-3; AROD-4742-2; AD-460393)

The Hall mobility measurements are still in the preliminary stage. Transient currents were observed in drift mobility measurements. Assuming observation of distorted space charge limited currents, the hole mobility is about twice the electron mobility and that the lower limit on the hole mobility is about 0.01 cm^2/V sec in the c^1 direction. Author

N65-20925# Army Missile Command, Huntsville, Ala. Physical Sciences Lab.
FINE STRUCTURE OF OPTICAL ABSORPTION BANDS IN NEUTRON IRRADIATED MgO
George A. Tanton, Romas A. Shatas, and C. Alton Coulter 15 Oct. 1964 57 p refs
(RR-TR-64-17; AD-459454)

The fine structure of optical absorption bands in neutron-irradiated MgO was observed at liquid He temperatures. Samples that had received a total integrated epicadmium neuton flux of 10^{16} neutrons/cm^2 were studied and compared to samples that received a total dosage of 10^{17} neutrons/cm^2 and 10^{18} neutrons/cm^2. An interpretation of the fine structure in terms of phonon creation and annihilation, based on earlier theories for broadband absorption, was attempted with emphasis on the 0-phonon line. Only the height of the 0-phonon transition depends upon the irradiation dose. The mirror symmetry of the absorption and the luminescence bands was also found. The Huang–Rhys factor was compared to values given by other authors for alkali halides. Essential agreement was found between values calculated from the theory given here and values found from the investigations of others for a given compound. Discrepancies exist in results obtained from calculating the Huang–Rhys factor in different ways. Author

N65-20964# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.
ON A HETEROGENEOUS CONCEPT OF SOLID MEDIA WORKING BEYOND THE ELASTIC REGION [SUR UNE CONCEPTION HETEROGENE DES MILIEUX SOLIDES TRAVAILLANT AU-DELA DU DOMAINE ELASTIQUE]
Robert Mazet and Gabriel Coupry 1964 16 p refs In FRENCH
Presented at the 11th Intern. Congr. of Applied Mech., Munich, 30 Aug.–5 Sep. 1964
(TP-162)

An hypothesis is advanced which considers a solid medium to be an agglomeration of grains. These grains are distributed in a unit volume according to a statistical law and have different creep thresholds. Using this concept, it is shown that, in the case of a lamellar structure having a dominant parameter and in the case of localized creep, any evolution of the structure under the given limiting conditions and forces can be predicted from test results of the same material acted on in simple traction. M.P.G.

N65-20999*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TRANSPORT PHENOMENA IN ALUMINUM OXIDE
Myron O. Davies Washington, NASA, Apr. 1965 14 p refs
(NASA-TN-D-2765) CFSTI: HC $1.00/MF $0.50

The results of available electrical conductivity determinations and self-diffusion measurements for aluminum oxide were reevaluated in terms of ionic mechanisms of transport. Four activation energies were found: 5.9, 2.6, 2.9, and 0.66 electron volts. These activation energies seem to be those, respectively, for intrinsic oxygen-ion motion, extrinsic oxygen-ion motion, intrinsic aluminum-ion motion, and extrinsic aluminum-ion motion. The conductivity of the polycrystalline aluminum oxide specimens used in this study is larger than previously reported data for aluminum oxide single crystals. The results for aluminum oxide are compared with those for magnesium oxide and appear to be consistent. Author

N65-21025# Naval Ordnance Lab., White Oak, Md.
DETERMINATION OF MOLECULAR FIELD COEFFICIENTS FOR TWO SUB-LATTICE MAGNETIZATIONS BY LEAST SQUARE FIT Mathematics Department Report M-44
Gerhard Heiche Feb. 1965 24 p
(NOLTR-64-6; AD-612383)

A method is developed which determines, for an experimentally obtained curve of total magnetization versus temperature, the molecular field coefficients of a two-sublattice model. These coefficients give a theoretical magnetization curve that fits best the experimental one. An IBM 7090 program which calculates these coefficients is described. Author

N65-21037 Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics
BEHAVIOR OF DRY POTASSIUM VAPOR IN ELECTRIC AND MAGNETIC FIELDS
J. L. Kerrebrock, M. A. Hoffman, and A. Solbes *In its* Res. on New Concepts in Energy Conversion 15 Mar. 1965 p 18–23 refs (See N65-21035 10-23)

More refined measurements of the dry vapor conductivity have been carried out, both with and without a magnetic field. A magnetic field was imposed on the plasma, perpendicular to the tube axis and to the magnetic field. This combination leads to a Hall field normal to both, which was measured by means of paired probes. Both the test section and the exit tube were heated to prevent condensation. A throat downstream of the test section was sized to give a Mach number of 0.6 in the test section. The results consist of axial and transverse voltages, as functions of the axial current and the magnetic field. The curves are linear, indicating that a nearly constant conductivity was attained in the plasma. From these and other similar results the plasma conductivity was determined as a function of the current density. Within the uncertainty of the plasma conditions, the measured conductivity agrees with that predicted theoretically. In the light of current understanding of two-temperature plasmas, this may be interpreted to mean that the electron collision cross section of potassium is 250×10^{-16} cm^2 within approximately 15%. E.P.V.

N65-21053# Army Electronics Labs., Fort Monmouth, N. J. Electronic Components Dept.
DIELECTRIC CONSTANT OF GERMANIUM AS A FUNCTION OF FREQUENCY, TEMPERATURE, AND RESISTIVITY
Maurice A. Druesne Jan. 1965 16 p refs
(ECOM-2553; AD-612897)

One of the most important characteristics of semiconductors is the dielectric constant which determines their electrical behavior. Measurements of the dielectric constant were made on p- and n-type germanium of various resistivities (20, 10, and 1/2 ohm-cm). At the same time the dielectric constant was found to decrease with lower temperatures down to 78° K.

Similarly, the dielectric constant was measured at various frequencies and found to decrease with increasing frequency. At very low resistivity (1/2 ohm-cm) some anomalous behavior is found which is due to the fact that the material is no longer really a semiconductor, but begins to act as a conductor.
Author

N65-21111# Oak Ridge National Lab., Tenn. Health Physics Div.
A NEW TECHNIQUE FOR MEASURING RANGE OF LOW ENERGY CHARGED PARTICLES IN CONDUCTING SOLIDS
A. K. Roecklein, M. Y. Nakai, E. T. Arakawa, J. L. Stanford, and R. D. Birkhoff (M.S. Thesis–Vanderbilt Univ.) Mar. 1965 58 p refs
(Contract W-7405-ENG-26)
(ORNL-3702) CFSTI: $3.00

A new method is described for measuring ranges of charged particles in conducting solids, and experimental data are presented for proton ranges in aluminum at energies less than 10 KeV. A thickness of aluminum greater than the maximum range of protons at this energy is evaporated onto a glass substrate in a system evacuated to 1.0×10^{-5} mm Hg. This layer is covered by an extremely thin (≤ 75 Å) layer of silicon monoxide. The proton beam was extracted from a radiofrequency ion source and accelerated to the desired energy by a series of anodes in an evacuated system. Author

N65-21112# India. Dept. of Atomic Energy, Bombay. Metallurgy Div.
DIMENSIONAL INSTABILITY IN CADMIUM DURING THERMAL CYCLING
M. L. Mehta and K. Tangri 1964 19 p refs
(AEET/MET/4)

The effect of grain size, the type of texture present and the cycling temperature range on the growth of Cd during thermal cycling was investigated. The growth behavior of Cd is found to be similar to that reported in other thermally anisotropic metals. However, the magnitude of growth, as compared to that observed in U, Zn and Zr, is far less than would be expected from theoretical consideration based on thermal anisotropy and yield strength of the metals considered. It is experimentally shown that low magnitude of growth in Cd is not due to its low recovery temperature or the grain coarsing which was observed during cycling. It is suggested that Cd is not provided with the type of texture necessary for producing optimum growth. Author

N65-21117# Massachusetts Inst. of Tech., Cambridge, Mass. Lab. for Insulation Research
CONDUCTION PHENOMENA IN RUTILE SINGLE CRYSTALS
John A. van Raalte Nov. 1964 37 p refs
(Contracts AF 33(616)-8353; Nonr-1841(10))
(TR-195; AD-610101)

The conduction properties of oxidized rutile single crystals were studied. Application of a constant dc field results in a rise of conductivity which normally leads to thermal breakdown if the current is not externally limited. The rate of rise of the conductivity is proportional to the magnitude of the electronic current; it reflects a change in the bulk of the crystal and is not due to changes in the electrode contact. Space-charge-limited currents were measured, but the effective mobility at room temperature is very low due to trapping. During current transfer an anode fall develops, which may eventually contain the main voltage. Rise in conductivity seems to be produced by two phenomena: filling of shallow traps with corresponding increase of the effective mobility, and injection of positive space charge as holes from the anode, which allows an increase in electron current by balancing negative space charge. Author

N65-21133# Laboratoire de Physique des Solides, Orsay (France).
X-RAY SCATTERING BY POINT-DEFECTS Technical Final Report
A. M. Levelut and A. Guinier [1964] 16 p refs
(Grant AF-EOAR-62-51)
(AFOSR-65-0060; AD-610006)

The analysis of a few examples of application of the apparatus permits determination of the domains where the method of scattering measurements is able to bring new results. The degree of order in solid solutions is one of the parameters which can be determined quantitatively with an interesting accuracy and more directly than by other methods. The true random solid solution seems to be exceptional and the general case is a tendency towards segregation or ordering. It appears possible to determine in dilute solutions the energy of pair formation. Author

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N65-20641# National Gas Turbine Establishment, Pyestock, (England).
A LABORATORY SCALE STUDY OF EROSION AND DEPOSITION DUE TO GAS BORNE SOLIDS
H. C. Duffin Aug. 1960 34 p refs
(NGTE-M-341)

In studying some of the variables affecting erosion and deposition by impacting particles, attention was given to particle size, shape, velocity and temperature, and impaction surface temperature. The coefficient of friction between the colliding materials was also considered. Tentative mechanisms were postulated to explain the observed results. Author

N65-20990*# National Aeronautics and Space Administration, Washington, D. C.
THE COEFFICIENT OF FREE TURBULENCE IN A JET OF ATOMIZED LIQUID FUEL [K VOPROSU O KOEFFITSIYENT SVOBODNOY TURBULENTNOSTI STRUI RASPYLENNOGO ZHIDKOGO TOPLIVA]
A. S. Lyshevskiy Apr. 1965 13 p refs Transl. into ENGLISH from Tr. Novocherkasskogo Politekhn. Inst. (USSR), no. 33/47, 1956 p 239–248
(NASA-TT-F-351)

The theory of the free turbulent jet is applied to the study of a jet of atomized liquid fuel. The study showed that the value of the coefficient of free turbulence can now be determined. Author

N65-20993*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
EFFECT OF OXIDIZER PARTICLE SIZE ON SOLID-PROPELLANT COMBUSTION STABILITY

Gerald Morrell and Murray L. Pinns Washington, NASA, Apr. 1965 15 p refs
(NASA-TN-D-2736) CFSTI: HC $1.00/MF $0.50

Amplitudes of the longitudinal-mode of oscillation were measured in side-vented cylindrical combustors loaded with a composite solid propellant. The binder consisted of a butadiene–carboxylic acid copolymer cross-linked with an epoxy resin, and the oxidizer was ammonium perchlorate. Mean oxidizer particle size was varied by changing the proportions of unground and ground perchlorate while keeping the total quantity constant at 81% by weight. The experimental results indicate a sharp rise in oscillation amplitude at a well-defined mean oxidizer particle size: 40% to 25% ground perchlorate in a 12-inch long combustor. A similarity parameter calculated on the basis that burning velocity is determined by the rate of turbulent mixing is shown to be in reasonable agreement with the observed behavior. A few experiments conducted with aluminized propellant indicate that the suppression effect associated with the aluminum addition is probably due to energy absorption at or near the surface. Author

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N65-20245# Curtiss-Wright Corp., Wood-Ridge, N. J.
SOME FUTURE POTENTIALS FOR VTOL ENGINES
A. F. Kossar [1964] 24 p refs Presented at the 20th Ann. Natl. Forum of the Am. Helicopter Soc., Washington, D.C., 13–15 May 1964

The VTOL problem places additional emphasis on the importance of high thrust to weight ratio and low specific fuel consumption for all engines in the aircraft, lift, lift-cruise or cruise engines. A number of design approaches influencing these factors in gas turbine cycles are reviewed. Two techniques have principal effect on improved engine thrust to weight ratio. The first technique concerns the potential for lightweight axial flow compressors where the light weight is the result of high work per stage and low structural weight per stage. The second concerns the potential for high work per unit airflow by means of high turbine temperature achievable with turbine blade cooling. A review of experimental results with both techniques is presented. With respect to fuel consumption, the influences of cycle parameters are described as well as possible improvements through one type of variable engine geometry. Author

N65-20302# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering
THRUST VECTORING WITH A PLUG NOZZLE BY PLUG TRANSLATION
William Joseph Barnes, Jr. (M.S. Thesis) Aug. 1964 87 p refs
(GA/ME/64-1; AD-610172)

The theoretical and experimental investigation of a convergent plug exhaust nozzle to determine if thrust vectoring could be achieved through the use of a translating plug, which traveled in plane motion across a base region of slightly increased diameter, is reported. Because certain two-dimensional aspects associated with the pressure differential existed, the study was reduced to the investigation of a two-dimensional convergent plug nozzle. The objectives were to determine the angle which the resultant thrust vector made with the axial direction when the plug was translated, and to determine the loss in axial plug wall thrust due to the step. Good qualitative correlation was obtained between the method of characteristics solution and experimental results. At a chosen value of nozzle pressure ratio of 6.15, the analytical solution predicted a resultant thrust vector angle of not quite 4 degrees. Experimental tests gave an angle nearer to 2 degrees. Further, the axial thrust produced by the plug wall contour was materially reduced by the step which existed for the translated plug. E.E.B.

N65-20365 Purdue Univ., Lafayette, Ind. Jet Propulsion Center
THREE-DIMENSIONAL NOZZLE DESIGN
H. D. Thompson *In its* 1964 Rev. of Res. [1964] p 213–236 refs (See N65-20351 10-33)

Optimization of three-dimensional nozzles to obtain maximum thrust when the initial conditions of flow and the length of the nozzle are fixed is reported. The compatibility equation for three-dimensional flow is obtained from the derived design equations, thus assuring the physical compatibility of the flow. The method of characteristics is reviewed, and the governing conditions and the formulation and solution of the problem are discussed. Application of the design equations to the actual design of a three-dimensional thrust nozzle involves first locating the control surface and computing the flow variables on it, and then computing the remainder of the flow field from the calculated flow variables on the control surface and the known flow variables in the kernel using the three-dimensional method of characteristics. The optimum thrust contour is determined by following streamlines from the throat contour. M.P.G.

N65-20367 Purdue Univ., Lafayette, Ind. Jet Propulsion Center
COLLOID ACCELERATION IN AIR
William F. Hassel and Donald F. Lilley *In its* 1964 Rev. of Res. [1964] p 257–283 refs (See N65-20351 10-33)
(Contract N123(60530)-34745A)

In preparation for a study of the motion imparted to atmospheric air by the interaction between the air and colloidal particles accelerated through it by a time-varying magnetic field, effort has been devoted to the design, fabrication, and testing of the experimental equipment. Micron-sized iron particles will be subjected to the accelerating forces of an oscillatory magnetic field created by the discharge of a capacitor bank through a coil suitable for generating the field. The theoretical basis for this concept of electrical propulsion, in which electrical power is used as a means of generating thrust within the atmosphere utilizing the atmosphere as the working fluid, is discussed. Auxiliary equipment that will be required is also indicated. M.P.G.

N65-20370 Purdue Univ., Lafayette, Ind. Jet Propulsion Center
SECONDARY INJECTION OF GASES INTO A SUPERSONIC FLOW
R. D. Guhse *In its* 1964 Rev. of Res. [1964] p 331–354 refs (See N65-20351 10-33)
(Grant NsG-592)

A parametric analysis of the amplification factor as a measure of the effectiveness of secondary injection was conducted in preparation for a systematic experimental program. The amplification factor, defined as the ratio of the equivalent specific impulse of the secondary stream to the specific impulse of the primary stream, was found to be directly proportional to the ratio of the acoustic stagnation speeds in the secondary and primary streams, and to a function of the point of injection, the angle of injection, the secondary flow rate, the secondary stream properties, and the injection port geometry. In the experimental program, data have been recorded for one injector location, and for both normal and 10° upstream injection angles. Air was used as the secondary gas in both cases, and secondary stagnation pressure and slot area were varied. The data obtained are discussed in relation to various theoretical models that have been proposed in the literature. M.P.G.

N65-20425*# Princeton Univ., N. J. Guggenheim Labs. for Aerospace Propulsion Sciences
AEROSPACE PROPULSION SYSTEM AND MISSION ANALYSES RESEARCH Status Report, 1 Feb. 1964–31 Jan. 1965
J. P. Layton 15 Mar. 1965 33 p refs
(Contract NASr-231)
(NASA-CR-57609) CFSTI: HC $2.00/MF $0.50

Progress in the past year is summarized for trajectory and orbit calculations, thrust and propulsion studies, and applied mathematics for related analysis. The information is extracted from previously published papers, and keyed to an attached bibliography. E.P.V.

N65-20453# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering
EFFECT OF CHAMBER PRESSURE ON THE PERFORMANCE OF A SMALL REVERSE-FLOW ROCKET ENGINE
John Clark Vaughan, III (M.S. Thesis) [1964] 97 p refs
(GE/ME/64-8; AD-610179)

Experimental tests were made on a small reverse-flow rocket engine utilizing gaseous hydrogen and oxygen as propellants. The engine was operated at chamber pressures from 50 to 150 psia and developed thrusts from 40 to 150 pounds. The majority of tests were conducted at chamber pressures of 60 to 100 psia. Results indicated that the same maximum value of the characteristic exhaust velocity ft/sec (7960 fps) and combustion efficiency (97%) were obtained for both these chamber pressures. However, with increasing chamber pressure the optimum mixture ratio increased. In addition, it was found that the best combustion chamber shape was spherical. Author

N65-20573# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROPULSION UNIT OF VERTICAL TAKE-OFF AIRCRAFT
Jaroslav Mrakava 12 Jan. 1964 14 p Transl. into ENGLISH from Letecky Obzor (Prague), v. 8, no. 4, 1964 p 114–116
(FTD-TT-64-834/1+2; AD-455538)

The problem of reducing takeoff and landing runway lengths is discussed. The principles of the helicopter and a vertical takeoff and landing aircraft (VTO) are reviewed. It was noted that the VTO aircraft with either jet or turboprop power plants requires up to two-fold efficiencies over conventional aircraft. Also, the noise of the helicopter is considered. In order for this type of aircraft to receive broad application, their flight properties must be improved so they can fly under all weather conditions, and operational and transportational costs must be reduced. E.E.B.

N65-20607# Brown Engineering Co., Inc., Huntsville, Ala. Research Labs.
A COMPARATIVE ANALYSIS OF THE PERFORMANCE CAPABILITIES OF VARIOUS TYPES OF ELECTROSTATIC PROPULSION ENGINES
A. Lucile Cox Feb. 1965 113 p refs
(R-136)

The operating characteristics of three types of atomic ion engines and three types of colloidal ion engines are evaluated. The major theoretical factors which will limit payload capacity are brought out for each type of engine. Total propulsion system masses for the production of 10 pounds of thrust for 2000 hours and for 10000 hours of engine operation are compared. Examination of the payload capacities of the various engines for several lunar and planetary missions shows that the colloidal ion engines have a superior payload capacity for lunar missions and may be competitive with atomic ion engines for planetary missions. The specific mass of the power supply system is shown to be a much more dominant factor in determining the payload capacities of the atomic ion engines than for the colloidal ion engines. Author

N65-20928# Library of Congress, Washington, D. C. Aerospace Technology Div.
HYPERSONIC RAMJET ENGINE, COMPREHENSIVE REPORT Surveys of Soviet-Bloc Scientific and Technical Literature
26 Mar. 1965 19 p refs
(ATD-P-65-16; AD-460186) CFSTI: HC $1.00/MF $0.50

Soviet efforts in the development of hypersonic ramjet engines, with particular emphasis on hardware aspects, were reviewed. A previously published survey of unconventional combustion processes did not reveal any significant Soviet effort in the development of a supersonic combustion process. Articles on an experimental apparatus for flow simulation in hypersonic inlet diffusers; analyses of optimum diffuser shapes; the flow over spikes, cones, and wedges; and a ribbed diffuser are evaluated. Methods for designing combustion chambers and analyses of their operation; the effect of different parameters on the length of the combustion zone; and the optimization of this length are also covered. Most of the articles on nozzles deal with contours, flow characteristics, shock formation, and heat transfer. E.E.B.

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N65-20621*# Space Technology Labs., Inc., Redondo Beach, Calif. Quantum Physics Lab.
THEORETICAL STUDY OF THE COUPLING BETWEEN THE SOLAR WIND AND THE EXOSPHERE Quarterly Status Report No. 6, 23 Sep.–22 Dec. 1964
F. L. Scarf 22 Dec. 1964 33 p refs
(Contract NASW-698)
(NASA-CR-57487; STL-8494-6006-SU-000) CFSTI: HC $2.00/MF $0.50

CONTENTS:

1. SUPERTHERMAL ELECTRON PRODUCTION IN THE TRANSITION REGION R. W. Fredricks, F. L. Scarf, and W. Bernstein 1 p ref

2. A POSSIBLE INTERPRETATION OF THE P-11 VLF MEASUREMENTS F. L. Scarf and R. W. Fredricks 1 p ref

3. CONDUCTIVE HEATING OF THE SOLAR WIND, II: THE INNER CORONA F. L. Scarf and L. M. Noble 29 p refs (See N65-20622 10-29)

N65-20622 Space Technology Labs., Inc., Redondo Beach, Calif.

CONDUCTIVE HEATING OF THE SOLAR WIND, II: THE INNER CORONA

F. L. Scarf and L. M. Noble *In its* Theoret. Study of the Coupling between the Solar Wind and the Exosphere, 22 Dec. 1964 29 p refs Submitted for Publication (See N65-20621 10-29)

New numerical solutions to the Navier–Stokes equations describe the streaming solar atmosphere. It is argued that no external heat input is needed beyond about $2R_\odot$ if the coronal base temperature is near 1.5×10^6 °K and the plasma has a uniform 10% concentration of helium. In the subsonic region, thermal conduction dominates the flow and viscous effects are unimportant. The transition to supersonic flow occurs near $7R_\odot$ and beyond this radius viscous forces are extremely significant. It is shown that solutions to the inviscid model are singular and that they are not related to the limiting solutions for small, but finite, viscosity. Author

N65-20626# Joint Publications Research Service, Washington, D. C.

COSMIC RAYS FROM THE SUN

L. I. Miroshnichenko 1 Apr. 1965 20 p Transl. into ENGLISH from Priroda (Moscow), no. 1, Jan. 1965 p 25–34 (JPRS-29382, TT-65-30628) CFSTI: $2.00

The behavior of solar particles close to the earth and the conditions of their acceleration and emergence from the sun are described. Also, the conditions of propagation of solar cosmic rays in interplanetary space are examined. Solar particles can come from the sun to earth in two ways—in the magnetic trap of a corpuscular flux or by diffusion in the heterogeneities of the interplanetary magnetic field. Both of these methods are discussed. Further, the problems of forecasting solar cosmic radiation dangers in space are evaluated. E.E.B.

N65-20670# Royal Aircraft Establishment, Farnborough (England).

SATELLITES AND CHARGED CORPUSCULAR RADIATION

M. J. Downey Sep. 1964 55 p refs (RAE-TR-64009)

The data and facilities required to estimate the lifetime of a satellite in a given orbit, from the point of view of radiation damage to its components, are discussed. A brief summary of measurements from chosen satellites is given, followed by considerations of radiation origins and the B,L coordinate system (a system for measuring force as well as incorporating the drift property of charged particles around the earth). The interaction of radiation with matter and the calculation of absorbed radiation doses are also described. Finally, the effects of radiation on various possible satellite components, such as semiconductors, polymers, etc. are outlined. Author

N65-20861# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE THEORY OF FORMATION OF SHOCK WAVES IN THE CHROMOSPHERE AND IN THE CORONA

S. A. Kaplan and L. A. Ostrovskiy 6 Jan. 1965 10 p refs Transl. into ENGLISH from Soln. Dannyye (USSR), no. 6, 1963 p 53–59 (FTD-TT-64-839/1; AD-610301)

The heating of the chromosphere and corona is explained by the hypothesis that the mechanism of heating consists of audio waves, originating in the subphotospheric layers during convective movements. These propagate upwards and at a certain altitude transform into shock waves, liberating heat. A method is described for considering the conditions of transformation of audio waves into shock waves at any given density and temperature distribution when the length of the audio wave is much smaller than the equivalent altitude and the perturbations are not great. E.E.B.

N65-20996*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

MODEL SOLAR PROTON ENVIRONMENTS FOR MANNED SPACECRAFT DESIGN

Jerry L. Modisette, Terence M. Vinson, and Alva C. Hardy Washington, NASA, Apr. 1965 25 p refs (NASA-TN-D-2746) CFSTI: HC $1.00/MF $0.50

A statistical analysis of the solar proton events occurring during the upper half (1956 to 1961) of the last solar cycle was made to determine the radiation environment which may be expected for flights outside the protection of the earth's magnetic field. Distribution functions were derived for both the event size (number of protons) and the spectral parameters for mission durations of 1 to 104 weeks. From these distribution functions, model environments are given, corresponding to various probabilities of occurrence. Author

N65-21000*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

THE SOLAR FLARE ENVIRONMENT

W. T. Roberts 12 Mar. 1965 38 p refs (NASA-TM-X-53216) CFSTI: HC $2.00/MF $0.50

Discussed is the solar atmosphere including the photosphere, chromosphere, and corona. Most of the main structures found within these areas are mentioned, and some are elaborated on. Next are described the various types of solar flares which have been observed. The problem of constructing a solar flare model is discussed, and percentile curves based on presently available data are suggested as a solution. These curves are drawn for the 99.9 percentile, 90 percentile, 67 percentile, and 50 percentile groups. Probabilities of solar flare occurrence, and methods now being used as a basis for studies on solar flare predicting are considered. It is concluded that even accurate solar flare predictions cannot alleviate the amount of shielding required for a long duration extraterrestrial mission. A few of the complications involved in solar shielding calculations are covered, and a possible means of approach to these problems is suggested for future extraterrestrial missions. Author

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles

N65-20164*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SIMPLIFIED TECHNIQUE FOR ABORTING A LUNAR LANDING MISSION DURING POWERED DESCENT USING MANUAL BACKUP GUIDANCE
David B. Middleton Washington, NASA, 1965 23 p refs
(NASA-TN-D-2724) CFSTI: HC $1.00/MF $0.50

An analytical study was made of a simplified technique for aborting the lunar-landing mission from along the powered-descent trajectory. The technique developed is feasible for use with the manual-backup guidance system of the landing spacecraft but could also be implemented with an automatic system. A circular chasing orbit at about a 50 000-foot altitude is used prior to a standardized transfer back to a command spacecraft parked in a circular orbit at 80 nautical miles. The emphasis of the study is on this return-transfer maneuver. An error analysis was made of a family of transfer orbits having pericynthions 50 000 feet above the mean lunar surface. The results of the study indicate that the abort technique is feasible and that reasonable errors in altitude, altitude rate, and thrust angle do not significantly affect the "miss" distance at rendezvous. Deviations from chasing-orbit circular velocity and errors in thrust cutoff can cause significant miss distances but may usually be prevented or corrected. When necessary, midcourse corrections can be made at apocynthion by thrusting along the velocity vector. Author

N65-20276# Czechoslovak Academy of Sciences, Prague.
ASTRONOMY YEARBOOK, 1965, VOL. 41 [HVEZDARSKA ROCENKA 1965, ROCNIK 41]
Jiri Bouska, Vladimir Guth, and Bedrich Onderlicka, comp. 1964 264 p In CZECHOSLOVAKIAN

Ephemerides are given for the positions of the sun, moon, planets, meteors, and major constellations during the year 1965. M.P.G.

N65-20348# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering
MAXIMUM STABLE ORBIT OF A DISTANT LUNAR SATELLITE
Jerry Eugene White (M.S. Thesis) Jul. 1964 111 p refs
(GA/MECH/64-2; AD-610232)

The general nature and limits of motion of a distant lunar satellite in a retrograde orbit are investigated. The equations of motion are those of the restricted three-body problem and are written considering a circular orbit for the moon about the earth, and modified to include the eccentricity of the moon's orbit to show its effect upon the orbital limits and stability of the satellite. Initial conditions chosen result in the largest, least eccentric orbit. The equations of motion were integrated numerically on a digital computer for up to 275 days. The maximum distance from the moon for a stable orbit was found to be about 43 000 statute miles. The effect of the eccentricity of the moon's orbit on the distant satellite was to make the orbit considerably more sensitive to changes in initial radius and to slightly reduce the maximum orbital radius and maximum initial radius. Author

N65-20381*# National Aeronautics and Space Administration, Washington, D. C.
[IMPORTANCE OF MAPPING TO THE SPACE PROGRAM] News Release
James E. Webb 31 Mar. 1965 24 p Presented at the Conv. of the Am. Soc. of Photogrammetry and Am. Congr. on Surveying and Mapping, Washington, D.C., 31 Mar. 1965 Available from the Scientific and Technical Information Division

Mapping of the earth and space environments is reported by NASA Director James E. Webb. Satellite data from various Mariner, Explorer, Ranger and Alouette probes have yielded information about the earth's surface, weather, cloud formations, solar winds, magnetosphere, and ionosphere. Study of the Van Allen belt and solar and celestial radiation is also summarized. The Ranger moon projects and the philosophy of space conquest are discussed. J.M.D.

N65-20408*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A SURVEY OF DATA ON MICROSCOPIC EXTRATERRESTRIAL PARTICLES
Richard A. Schmidt Washington, NASA, Mar. 1965 136 p refs
(NASA-TN-D-2719) CFSTI: HC $4.00/MF $1.00

A brief description is given of various kinds of dusts and micrometeorites, including their sizes, physical properties, chemical composition, occurrence, annual deposit, and theories of origin. A long appendix gives a chronological summary of work on microscopic extraterrestrial particles carried out between 1945 and 1964. Tables are presented that treat classifications of these particles; their sizes; their physical properties, chemical analyses, outer space concentration estimates, annual deposition estimates, and sources; and locations of collections of them on the earth's surface. An extensive bibliography is included. D.E.W.

N65-20422*# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
EXPERIMENTAL INVESTIGATION OF ULTRA-HIGH VACUUM ADHESION AS RELATED TO THE LUNAR SURFACE Second Quarterly Progress Report, 1 Oct.–31 Dec. 1964
J. A. Ryan 26 Jun. 1964 22 p refs
(Contract NAS7-307)
(NASA-CR-57631; A260-BBK2-57) CFSTI: HC $1.00/MF $0.50

Silicate adhesion data on ultra-high vacuum friction–adhesion were obtained from orthoclase samples. These data are not conclusive due to the presence of vibrations and the development of a vacuum system leak during the high temperature outgassing. A crystalline orientation dependence was detected and seems to indicate ionic-covalent binding forces. Data taken at atmospheric pressure and at 10^{-3} mm Hg indicate that uniform surface charging is not important for adhesion. G.G.

N65-20442# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering
EXPLOITATION OF LUNAR WATER RESOURCES
Michael Vincent Vasilik (M.S. Thesis) Aug. 1964 85 p refs
(GSF/MECH-64-41; AD-610226)

This report discusses the technical feasibility of exploiting natural lunar water resources. Brief consideration is given to utility, possible abundances, and location of hydrous deposits. The criteria for design of new equipment or adaptation of existing equipment are specified. Based on these criteria, various proposed designs of extraction, electrolysis, and liquefaction equipment are evaluated. Particular emphasis is given to the effects of reduced lunar gravity on operation and design. Extraction equipment under discussion includes separators, evaporators, condensers, compressors, and pumps. Rotating, vortex, membrane, vapor, and porous electrode electrolysis cells are considered. A rotating cell with a palladium cathode appears to be the most promising. For liquefaction of oxygen and hydrogen, engine expansion is found preferable to Joule–Thomson expansion. Author

N65-20458# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering
THE EFFECTS OF GRAVITY ON THE BEARING CAPACITY OF COHESIONLESS SOILS
James Edward Lynch and Cornelius Joseph Higgins (M.S. Thesis) Aug. 1964 134 p refs
(AD-610227)

The effect of gravity on the strength of cohesionless soils is investigated. Coulomb's equation for shearing strength and Terzaghi's bearing capacity theory are analyzed to determine theoretically the influence of gravity. Penetrometer experiments were performed on six soil models under gravity forces of 0, 0.168, 1, and 2 times that of the earth. The experimental results show that the ultimate bearing capacity of cohesionless soils is directly proportional to the gravity field. This is the result predicted on the basis of Terzaghi's bearing capacity theory. Author

N65-20480*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECTS OF MAGNETICALLY INDUCED EDDY-CURRENT TORQUES ON SPIN MOTIONS OF AN EARTH SATELLITE
G. Louis Smith Washington, NASA, Apr. 1965 31 p refs Corrected Copy
(NASA-TN-D-2198) CFSTI: HC $2.00/MF $0.50

One source of torques on near-earth satellites is the interaction of the earth's magnetic field with eddy currents induced in the electrically conducting parts of a spinning satellite. The geomagnetic field is assumed that of a space-fixed dipole. The equation for the average torque, due to this effect, acting on a satellite of known properties is derived and presented. This equation shows the variation of the torque with the orbital parameters. The time history of the spin vector as influenced by this torque has been investigated. For the general case, the spin vector can be resolved into three orthogonal components which are damped exponentially at three different rates. The analysis is extended to include the effect of the tilt of the geomagnetic dipole axis with respect to the earth's spin axis. The analysis and equations which include this effect closely parallel the preceding analysis and equations. The generalized parameters, which can be used in analyzing the motion due to eddy currents of any spinning satellite in a near-circular orbit, are presented in graphical form. Author

N65-20551# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
OBSERVATIONS OF A PARTIAL LUNAR ECLIPSE ON MARCH 24, 1959
M. A. Milkhikyer Jan. 1965 10 p refs Transl. into ENGLISH from Byull. Vsesoyuz. Astronomo-Geod. Obshchestva (Moscow), no. 27(34), 1960 p 32–36
(RSIC-368; AD-612373)

Russian observations of the partial lunar eclipse by reflex camera, integral lensless photometry, binoculars, and the naked eye are described. Data obtained from the photometric observations indicate that the stellar magnitude of the lunar disc decreased by $3^{M}.05$ at its maximum phase resulting in an unusual darkness. Photographs of the phases did not produce good images, due to a malfunction. G.G.

N65-20564# Lund Observatory (Sweden).
THE PROBLEM OF THE RADIAL EXTENSION OF OBSCURE NEBULI [LE PROBLEME DE L'EXTENSION RADIALE DES NEBULEUSES OBSCURES]
Carl Schalen [1963] 20 p refs In FRENCH Presented at l'Obs. Royal de Belgique, 19–21 Nov. 1963 *Its* Medd. Ser. I, No. 208

The problem of whether obscure nebulae are screens without appreciable radial extension or broadened clouds is reviewed. The difficulty in resolving this problem depends principally on the fact that the dispersion of the absolute magnitudes of the stars leads to an apparent broadening. If, in reality, the cloud is a screen without extension, this broadening apparently increases with the dispersion. A heterogeneous distribution of the absorbing material occurring to the studied region gives an analogous, although much smaller, effect if the region is strictly bounded. The cumulative and differential diagrams of Wolf are discussed, and the numbering of stars in the Cocher and Cepheus nebulae is studied. Finally, a method based on color excess is described and applied to these nebulae. M.P.G.

N65-20575 Royal Observatory, Edinburgh (Scotland).
RECOGNITION OF RAPIDLY ROTATING POLE—ON B-TYPE STARS
B. N. G. Guthrie Edinburgh, HMSO, 1965 15 p refs *Its* Publications, Vol. 3, No. 8 HMSO: 3s

The B-type stars reported as having weak helium lines for their spectral types are discussed. The strengths of other lines are examined to determine whether the weakness of the helium lines is due to abnormal abundances or to rapid stellar rotation observed pole-on. In the latter case the effective temperature and surface gravity will be high in the polar regions and low in the equatorial regions. Spectral lines corresponding to a low temperature and surface gravity are present in the stars HD 37058, α Scl, and 20 Tau, and it is concluded that these are probably rapidly rotating pole-on stars. The helium lines are weak since they are formed only in the polar regions where the effective temperature is high. Author

N65-20609*# National Aeronautics and Space Administration, Washington, D. C.
THE NATIONAL SIGNIFICANCE OF THE AUGMENTED PROGRAM OF SPACE EXPLORATION
Hugh L. Dryden [1961] 11 p

Dr. Hugh L. Dryden, the National Aeronautics and Space Administration, reviews the beginning of space exploration from the launching of the first manmade satellite, and discusses the four general objectives of the U.S. space program. These are: (1) to study the space environment by scientific instruments launched into space by sounding rockets, space probes, earth satellites, and artificial planets; (2) to begin the exploration of space and the solar system by man himself; (3) to develop earth satellites for peaceful purposes to promote human welfare; and (4) to apply space science and technology to military purposes for national defense and security. G.G.

N65-20669# Royal Aircraft Establishment, Farnborough (England).
SCALE HEIGHT IN THE UPPER ATMOSPHERE, DERIVED FROM CHANGES IN SATELLITE ORBITS
D. G. King-Hele and J. M. Hughes London, Min. of Aviation, Feb. 1962 55 p refs
(RAE-TN-SPACE-4)

The density scale height H in the upper atmosphere is a measure of the rate at which air density p varies with height y, being given by $H = -p/(dp/dy)$. Methods are developed for finding H from the decrease in a satellite's perigee height, and from the decrease in the orbital period of a satellite in a small-eccentricity orbit. These methods are then applied to all the 14 satellites found suitable for the purpose. The 44 values

of H obtained, for heights of 200 to 450 km, represent an average over day and night and probably have errors (s.d.) of 5% to 10%. It is found that, as solar activity declined between 1957 and 1961, H decreased greatly; e.g., at height 275 km, H decreased from 60 km in early 1958 to 40 km in 1960–1. The results also show that the increase of H with height becomes much less rapid above 350 km, and they are consistent with the supposition that H had low values, near 35 km, at heights near 250 km, for 1959–61. The results could be greatly extended in scope and improved in accuracy if more accurate orbits were available for short-lifetime satellites. Author

N65-20671# Royal Aircraft Establishment, Farnborough (England).
ORBITAL PARAMETERS OF TRANSIT 1 B (1960 γ 2), JUNE 2–10, 1962
R. H. Merson and A. T. Sinclair Oct. 1964 18 p refs
(RAE-TR-64036)

To determine its orbit during the early part of June 1962, 126 visual observations of the satellite TRANSIT 1B were used. A table of orbital parameters is given for 6 nodes spaced at 25-node intervals. Less than 20% of the observations were rejected during the analysis and the accuracy of the accepted observations was found to conform to the a priori estimates. Author

N65-20677# Royal Aircraft Establishment, Farnborough (England).
A PEGASUS COMPUTER PROGRAMME FOR THE IMPROVEMENT OF THE ORBITAL PARAMETERS OF AN EARTH-SATELLITE
R. H. Merson London, Min. of Aviation, Aug. 1962 31 p refs
(RAE-TN-SPACE-16)

The dynamic model adopted for the motion of a satellite includes the first-order short-period and secular perturbations of the orbital elements due to earth's oblateness, and other perturbations of the elements are represented by polynomials in time up to the third degree. The values of the six basic elements at a given time, together with such polynomial coefficients as are required, are determined from a set of observations by a differential correction technique. In this procedure, the observation times and angles are weighted according to a priori estimates of their accuracy. In addition to the estimates of the orbital parameters, estimates of their variances and covariances are also determined. Author

N65-20678# Royal Aircraft Establishment, Farnborough (England).
THE PERTURBATIONS OF A SATELLITE ORBIT IN AN AXISYMMETRIC GRAVITATIONAL FIELD
R. H. Merson London, Min. of Aviation, Feb. 1963 52 p refs
(RAE-TN-SPACE-26)

The equations for the variation of the osculating elements of a satellite are integrated to yield the complete perturbations of the first-order due to the second harmonic in the earth's field, together with the secular perturbations of the second-order due to the second harmonic and of the first order due to the third to sixth harmonics. A set of smoothed elements is then derived for which the first-order short-period oscillations have the smallest possible amplitudes. Author

N65-20705# Gt. Brit. Dept. of Scientific and Industrial Research.
KINETHEODOLITE OBSERVATIONS OF SATELLITES RECEIVED BY THE PREDICTION SERVICE FROM MALTA JULY 1964 (PART A)
1965 77 p *Its* Issue No. 1

N65-20724* National Aeronautics and Space Administration, Washington, D. C.
RANGER IX POST-IMPACT, PRESS CONFERENCE News Release
William H. Pickering, Gerard P. Kuiper, Eugene Shoemaker, Harold Urey, Harris M. Schurmeier et al 24 Mar. 1965 24 p

The National Aeronautics and Space Administration presents the minutes of the Ranger IX postimpact press conference. A movie of the "A" frames photographs was presented and discussed by the experimenters in attendance. Emphasis was put on the observation of the three craters Alpetragius, Ptolemaeus, and Alphonsus in the impact area, and the smoothness of the large crater walls, and the central peak and the central ridge running through Alphonsus. G.G.

N65-20745# Royal Aircraft Establishment, Farnborough (England).
ON CHANGING THE ORBITAL INCLINATION OF A SATELLITE
G. B. Longden London, Min. of Aviation, Nov. 1962 59 p refs
(RAE-TN-SPACE-20)

This note investigates the problem of a satellite vehicle which arrives at the correct orbital height but with the velocity inclined to the desired orbital plane. It is shown that under some circumstances, a bielliptic transfer is more economical than a direct turn, particularly for large values of the inclination. Arrival speeds are considered between 0·6 and 1·4 times circular orbital speed and inclinations between 0° and 90°. Contours of the characteristic speeds for the most economical maneuvers found are plotted. Author

N65-20746# Royal Aircraft Establishment, Farnborough (England).
ORBITAL PARAMETERS FOR SPUTNIK 4 ROCKET
R. H. Gooding London, Min. of Aviation, May 1964 14 p refs
(RAE-TN-SPACE-66)

About 500 visual observations of Sputnik 4 rocket, usually accurate to about 0.3 sec in time and 10′ in angle, were used to derive the orbit of the rocket during its 2-month lifetime. A table of orbital parameters is presented at intervals of 50 nodes. Standard deviations are given, showing that eccentricity, for example, was determined to an accuracy of about 0.0003. The worth of the observations is assessed on the basis of residuals, using the computed parameters. Author

N65-20752*# Martin Co., Baltimore, Md.
EXTENSION OF EFFORT FOR LUNAR FLIGHT HANDBOOK Detailed Technical Report
F. A. Santora, R. G. Salinger, G. Kovatch, and J. G. Gegner Dec. 1964 267 p refs
(Contract NAS8-5031)
(NASA-CR-57726; ER-13550-III) CFSTI: HC $6.00/MF $1.25

Technical discussion and data are provided as an extension to the previously published Orbital and Lunar Flight Handbooks. These results are to be incorporated into the subject manuals at a later date. Orbital departure windows, stability and mission potential of the libration points, orbit estimation, orbiter theory, and orbital operations are considered for the lunar flight. E.E.B.

N65-20776# Uppsala Univ. (Sweden).
PHOTOELECTRIC MEASUREMENTS OF MAGNITUDES AND COLOURS FOR 849 STARS
Bertil Ljunggren and Tarmo Oja 1964 28 p refs *Its* Arkiv Astron. Vol. 3, No. 31

Photoelectric measurements of mainly low galactic latitude stars studied in Sweden from 1956 to 1963 are presented. All data have been reduced to zenith and brought to a common system by means of standard stars observed every night. The lists include equatorial coordinates, the Bonner Durchmusterung number, the Henry Draper number, the Bayer designation or Flamsteed number, the visual magnitude and color as defined by Johnson, the number of measurements, and the colors in the instrumental system. G.G.

N65-20783# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering

AN ERROR ANALYSIS OF LUNAR RETURN TRAJECTORIES

Richard L. Hepburn (M.S. Thesis) Jan. 1963 73 p refs

(GAW/MECH-62-14; AD-610238)

The sensitivities of ballistic lunar return trajectories to errors in burnout flight path angle and velocity are examined. Only those trajectories which reenter the atmosphere at a shallow flight path angle in the vicinity of the reentry corridor have been included. The derivations included are based on a stationary earth–moon system and employ the sphere-of-influence concept. The calculations were done on an IBM 1620 digital computer. A listing of the computer programs is included. It was found that the shallower the reentry angle the more sensitive the trajectory. The sensitivities to angular error increase with increasing burnout velocity, whereas the sensitivities to velocity error decrease. A launch location was found at which the sensitivity to velocity error was essentially zero. This location was suspect because of the assumptions, but it was concluded that there were launch locations with minimum guidance requirements. Author

N65-20784# RAND Corp., Santa Monica, Calif. Aero-Astronautics Dept.

INFLUENCES OF SMALL DIFFERENCES IN BALLISTIC COEFFICIENT ON SATELLITE STATION KEEPING

Shih-Yuan Chen Jan. 1965 15 p refs

(P-3041; AD-609880)

Drift distance between two satellites caused by small difference in ballistic coefficient was investigated. The mathematical analysis was limited to circular orbits at altitudes less than 400 miles where atmospheric drag had the dominating effect on orbit decay, and where the effects of solar radiation pressure were also negligible. A closed-form solution is presented for satellite anomaly as a function of altitude in which it is assumed that the density is an exponential function of altitude. The U.S. Standard Atmosphere data for 1962 were applied to equations for earth satellite lifetime in circular orbit; calculations were then made on effects of differences in ballistic coefficient on satellite circumferential drift distance for various initial and final altitudes. J.M.D.

N65-20799*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.

THE ATMOSPHERES OF MARS, VENUS AND JUPITER

J. I. Rasool and Robert Jastrow [1963] 56 p refs Presented at the Symp. on Extraterrestrial Biol. and Org. Chem. at 4th COSPAR Meeting, Warsaw, 3–12 Jun. 1963

(NASA-TM-X-56223) CFSTI: HC $3.00/MF $0.50

Since composition, temperature, and pressure are the three parameters which determine the structure of a planetary atmosphere, these are discussed by considering the processes by which the planetary atmospheres evolved. The reliable physical data for the planet Mars are summarized. Considerably less is known about Venus. However, the physical constants of the planet and the current hypotheses regarding its structure are given. Also, relatively little is known about the structure of the atmosphere of Jupiter. Being five times farther removed from the sun than the earth, but having a comparable albedo of 0.47, the effective temperature of the planet is only 105° K. The high surface gravity and low temperature together suggest that the gravitational escape of gases from the planet should be extremely inefficient and the chemical composition of the atmosphere should still be primitive, containing large quantities of hydrogen and helium. E.E.B.

N65-20800*# National Aeronautics and Space Administration, Washington, D. C.

FUTURE MANNED EARTH ORBITAL ACTIVITIES

M. J. Raffensperger [1964] 11 p Presented at the Natl. Space Club, Washington, D.C., 25 Nov. 1964

(NASA-TM-X-56227) CFSTI: HC $1.00/MF $0.50

Space stations which carry man as an integral part of the spaceborne facility are discussed by M. J. Raffensperger, NASA's Director of Advanced Earth Orbital Missions. Man's usefulness as a flexible and intelligent scientific operator with the capability to observe and capitalize on unforeseen events is stressed. Since the biomedical and behavioral reactions to long-duration space missions are not yet quantitatively understood, these reactions will receive major attention in the earlier earth orbital flights. Proposed space science experiments in the areas of astronomy, bioscience, physics, and chemistry are discussed. Orbital space stations offer unique advantages for meteorological studies and earth mapping and surveys, as well as communications, arms control, and navigation, and air traffic control. The orbits that would be most beneficial for these purposes are considered briefly. Simple extensions of the Apollo Command and Service Modules used in conjunction with a Lunar Excursion Module ascent stage would permit near-earth orbital durations of up to 90 days. A space station with a six- to nine-man capacity is envisioned as the next phase, and the results of preliminary studies for such a station are discussed briefly. M.P.G.

N65-20825*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

C_2 SWAN BANDS IN COMETS

Ralph E. Stockhausen and Donald E. Osterbrock (Washburn Obs., Madison, Wis.) Aug. 1964 16 p refs

(NASA-TM-X-55130; X-614-64-232)

The relative populations of the vibrational levels of the $X\ ^3\Pi$ and $A\ ^3\Pi$ electronic levels are calculated assuming the fluorescence mechanism. Pure vibrational transitions are taken into account by making a rough estimate of the magnetic-dipole transition probabilities. Both the approximate method, Rosseland's theory of cycles applied to a 3-level molecule, and the accurate solution of the equations of statistical equilibrium for a 10-level molecule, give similar results. The excitation temperatures derived from these relative populations agree satisfactorily with the observations of the Swan bands by McKellar and Climenhaga (1953) for various sun-comet distances. Finally, an estimate is made of the infrared radiation, due to pure vibrational transitions, expected from a bright comet. The expected amount of radiation is small and will be difficult to detect. Author

N65-20879*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

A METEOROID ENVIRONMENT FOR NEAR-EARTH, CIS-LUNAR, AND NEAR-LUNAR OPERATIONS

Paige B. Burbank, Burton G. Cour-Palais, and William E. Mc Allum Washington, NASA, Apr. 1965 23 p refs

(NASA-TN-D-2747) CFSTI: HC $1.00/MF $0.50

A meteoroid environment model is presented for operations in the near-earth and cislunar regions and on the lunar surface. The model includes the average logarithmic flux-mass relationship, velocity, and mass density for sporadic, stream, and secondary (lunar surface ejecta) meteoroids. An annual variation of the average sporadic flux and the time-dependent variation of the stream to the sporadic flux ratio for 18 streams is graphically represented. The variation of the stream flux with mass is considered, and orbital elements are provided for the major streams. Author

N65-20898# Army Map Service, Washington, D. C.
HORIZONTAL AND VERTICAL CONTROL FOR LUNAR MAPPING. PART ONE: METHODS
Marvin Q. Marchant Aug. 1960 40 p refs
(TR-29; AD-262889)

Methods for the determination of first- and second-order lunar control are presented in this report. At the time of publication the process of determining the first-order control was almost completed. Author

N65-20944# Lund Observatory (Sweden).
STUDIES OF THE MILKY WAY FROM CENTAURUS TO NORMA. I: UBV PHOTOMETRY
Gösta Lynga 1964 30 p refs *In* Acta Univ. Lundensis, Sectio II, No. 11, 1964 *Its* Medd. Fran Lunds Observatorium, Ser. II, No. 139

The results are presented of a UBV photometry of stars in a part of the Southern Milky Way. The object of this work is to form a basis for a study of some open clusters. Author

N65-20945# Lund Observatory (Sweden).
STUDIES OF THE MILKY WAY FROM CENTAURUS TO NORMA. II: OPEN CLUSTERS
Gösta Lynga 1964 22 p refs *In* Acta Univ. Lundensis, Sectio II, No. 13, 1964 *Its* Medd. fran Lunds Observatorium, Ser. II, No. 140

The results are given from a survey of open clusters made on the basis of photographic plates from the Schmidt telescope of the Uppsala Southern Station at Mount Stromlo. As a result 14 suspected new clusters are presented and earlier listed objects with doubtful cluster characteristics are described. A detailed study of six open clusters is given. Author

N65-20946# Lund Observatory (Sweden).
STUDIES OF THE MILKY WAY FROM CENTAURUS TO NORMA. III: OB STARS
Gösta Lynga 1964 44 p refs *In* Acta Univ. Lundensis, Sectio II, No. 15, 1964 *Its* Medd. Fran Lunds Observatorium, Ser. II, No. 141

Objective prism plates from a 50/65-cm Schmidt telescope were searched for faint OB stars between galactic longitudes $l^{II} = 310°$ and $l^{II} = 334°$ and as a result a catalog of 482 objects is given, classified into three luminosity classes. The apparent distribution of the OB stars in the region studied shows three concentrations of which two are probably OB associations. Author

N65-20947# Lund Observatory (Sweden).
STUDIES OF THE MILKY WAY FROM CENTAURUS TO NORMA. IV: GALACTIC STRUCTURE
Gösta Lynga 1965 18 p refs *In* Acta Univ. Lundensis, Sectio II, No. 3, 1965 *Its* Medd. fran Lunds Observatorium, Ser. II, No. 142

The position of the nearest spiral arm between the sun and the galactic center is discussed, using results from the preceding papers as well as other published data. From a plot of spiral tracers as projected on the galactic plane it is inferred that the Sagittarius arm and the Carina arm form one arm resembling a logarithmic spiral with a pitch angle of about 73°. Author

N65-20948# Lund Observatory (Sweden).
STUDIES OF THE MILKY WAY FROM CENTAURUS TO NORMA A Summary
Gösta Lynga 1965 9 p refs *Its* Medd. Fran Lunds Observatorium, Ser. II, No. 143

Studies of the Southern Milky Way from Centaurus to Norma are summarized. Surveys of different kinds of objects are described. The main approach to optical studies of galactic features is that of photometric studies of objects that can be expected to line up spiral structure. Relevant cluster photometry is discussed. Also, an attempt to interpret present data in terms of galactic structure is reviewed. E.E.B.

N65-20978*# Cornell Univ., Ithaca, N.Y. Center for Radiophysics and Space Research
EFFECTS OF RADIATION FORCES UPON THE ATTITUDE OF AN ARTIFICIAL EARTH SATELLITE
Thomas F. Clancy and Thomas P. Mitchell Sep. 1962 83 p refs (Grant NsG-184-60)
(NASA-CR-57791; CRSR-129) CFSTI: HC $3.00/MF $0.75

The sources of radiation considered are direct solar radiation, solar radiation reflected by the earth and its atmosphere, and direct radiation from the earth. For these three cases the forces and torques acting on an arbitrarily shaped satellite are derived. The results are in integral form and are dependent upon the satellite's surface geometry as well as upon its orientation relative to the earth and sun and its mass distribution. The effects of the radiation torques upon the otherwise unperturbed motion of the satellite about its center of mass can be divided into two motions: motion of the axis of symmetry about the satellite's angular momentum vector (relative to its center of mass), and motion of the angular momentum vector. For the sources considered, the motion about the angular momentum vector is an unperturbed Euler–Poinsot motion, and the angular momentum vector itself, while remaining practically constant in magnitude, precesses and nutates relative to inertial space. This latter motion is described relative to the earth–sun line for direct solar radiation and relative to a perigee coordinate system for reflected solar and direct earth radiation. Author

N65-21004*# Consultants and Designers, Inc., Arlington, Va.
RADIOASTRONOMICAL OBSERVATIONS OF THE SOLAR ECLIPSE OF 21 JULY 1963 IN CENTIMETER WAVELENGTHS [RADIOASTRONOMICHESKIYE NABLYUDENIYA SOLNECHNOGO ZATMENIYA 21 IYULYA 1963 G V SANTIMETROVOM DIAPAZONE VOLN]
A. R. Abbasov, A. S. Grebinskiy, M. S. Durasova, V. A. Ivanov, L. M. Ignat'yeva et al 2 Apr. 1965 12 p refs Transl. into ENGLISH from Vestn. Leningrad. Univ. Astron. (Leningrad), v. 1, no. 1, 1965 p 102–109
(Contract NAS5-3760)
(NASA-TT-F-9862; ST-RA-SP-10313) CFSTI: HC $1.00/MF $0.50

Results of radioastronomical observations of the solar eclipse of 21 July 1963 in the centimeter band are presented. It is found that the sun's radiodiameter, determined in the 2- to 10-cm wavelength range, depends little on wavelength. The spectrum of the radio emission source situated above a small group of sunspots had a maximum in the 3.2- to

10-cm region. Comparison is made with measurements of the same source with the aid of radiotelescopes of high resolution carried out in U.S.S.R., Japan, and the U.S.A. corroborating the above findings. Author

N65-21005*# Consultants and Designers, Inc., Arlington, Va.
ON VENUS MODEL WITH "COLD" ABSORBING ATMOSPHERE [O MODELI VENERY S "KHOLODNOY" POGLOSHCHAYUSHCHEY ATMOSFEROY]
A. D. Kuz'min 6 Apr. 1965 16 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Radiotekhn. (Kiev), v. 7, no. 6, 1964 p 1021–1031
(Contract NAS5-3760)
(NASA-TT-F-9663; ST-LPS-10314) CFSTI: HC $1.00/MF $0.50

The possibility is considered of interpreting the observed Venus radio emission spectrum in centimeter and millimeter bands by wave absorption in the atmosphere aerosol of the planet. It is shown that the steep slope in the millimeter band of the spectrum may be explained by absorption in trickle-liquid aerosol at ~300° K and containing 0.2 to 0.3 g cm^{-2} of polar liquid with $3.5 \cdot 10^{-12}$ sec relaxation time. Such liquids can be constituted by some functional derivatives of methane CH_4, ethane C_2H_6, benzol C_6H_6, and others. Dust aerosol, consisting of rocks and volcanic formations, does not satisfy the experimental data. It is shown that the atmosphere model, yielding to the observed radiospectrum, must be entirely non-transparent in the infrared and optical bands. Therefore, the surface heating of the planet cannot be the result of direct solar radiation. Surface heating by the planet's inner heat is also considered, and the necessary heat flow is estimated. The possibility of explaining the measured Venus brightness temperature decrease in decimeter band by wave absorption in relatively cold Venus ionosphere (~300° K) is indicated. Author

N65-21012# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ASCENDING MOVEMENT OF ROCKET IN THE GRAVITATIONAL FIELD
A. V. Fokin 13 Jan. 1965 14 p ref Transl. into ENGLISH from Tr. Inst. Teor. Astron. (Alma-ata), v. 8, no. 5, 1962 p 335–342
(FTD-MT-64-316; AD-612377)

Considered is the ascending movement of a rocket whose mass is changed according to exponential law in the earth's gravitational field without calculation of resistance of the medium. The solution is expressed by elliptical integrals of the first and second order. Author

N65-21015# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE COSMOS AND THE FEELING OF SPACE
M. D. Yemel'yanov 2 Feb. 1965 10 p Transl. into ENGLISH from Zdorov'ye (USSR), no. 7, 1963 p 2–3
(FTD-TT-64-897/1+2; AD-611016)

The state of weightlessness in space flight is discussed, and the specific irritants to the vestibular apparatus are considered. The sensations which a human would experience from the sudden stopping of a centrifuge in which he was located are examined. The article concludes with recommendations for exercises which future space travelers should use in preparing for the sensations of space travel. E.E.B.

N65-21020# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
SPECTROPHOTOMETRIC OBSERVATIONS OF LUNAR CRATERS
N. P. Barabashov and V. I. Yezerskii Jan. 1965 10 p refs Transl. into ENGLISH from Izv. Komis. po Fiz Planyet (USSR), no. 3, 1961 p 50–55
(RSIC-361; AD-612878)

Data on differences in the spectral reflectance of separate sections of lunar craters were obtained to study morphological peculiarities of different lunar regions and to determine any changing or active processes. The central hill, eastern and western ridges, and the bottom eastward and westward from the central hill were examined by precise orientation of the spectrograph. No significant anomalies in the reflectance of the separate sections of the craters were observed. After applying an averaging procedure, a slight increase in the spectral reflections of the central hill as compared to the increase of wavelengths of the crater Alphonse was found. The central hill was somewhat redder ($\sim 0^{M}.08$) than the crater. The differences found between the craters and hills of Copernicus and Eratosthenes were within the limits of errors. The curve for Theophilus is analogous to that of Alphonse, whereas a reverse dependence is found for the crater Posidonius. M.P.G.

N65-21070# Tokyo Astronomical Observatory (Japan).
FREQUENCY OF CESIUM RESONATOR ON ET DETERMINED IN TOKYO
Shigetaka Iijima 20 Jun. 1964 4 p refs *Its* Tokyo Astron. Bull., 2nd Ser., No. 165

Frequency of cesium resonator was reexamined by comparing the integrated time system AT based on cesium resonator, with the ephemeris time determined from moon's observations made in Tokyo during from 1955 to 1962. The correction to be applied to the present value of the cesium frequency, 9,192,631,770 cps, for keeping the AT in parallel with ET has been obtained as $+24 \pm 10$cps. That is, the frequency on ET has been proved to be 9,192,631,794 cps. Author

N65-21110# Tokyo Astronomical Observatory (Japan).
POSITIONS OF MINOR PLANETS AND PLUTO (4)
H. Kosai and K. Tomita 20 Dec. 1964 17 p *Its* Tokyo Astron. Bull. Ser. 2, No. 166

Positions obtained by astrograph measurements from Tokyo, Japan from 1953–1955 are given. Pluto and various minor planets were among the objects observed. E.P.V.

N65-21114*# National Aeronautics and Space Administration, Washington, D. C.
SPACE—THE CHALLENGE AND THE RESPONSE News Release
James E. Webb 8 Apr. 1965 22 p Presented at the Naval Acad., Annapolis, 8 Apr. 1965

James E. Webb, Administrator, National Aeronautics and Space Administration, discusses the challenge which the space age presents with its basic expansion and alteration in the human environment, and the appearance of a new technology to master that environment. The interdependence of military and civilian space technology led to an increase in national power and position, new knowledge, the establishment of strategic international economic advantages, the wide use of new resources, great advances in military capability, and a quickening of national pride and vigor. The most formidable aspect of this overall challenge is the entry of man himself into space. G.G.

N65-21130# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering
LUNAR EXCAVATION TECHNIQUES IN ROCK
Joseph John O'Kobrick (M.S. Thesis) Aug. 1964 126 p refs (GSF/MECH-64-38; AD-610225)

Excavation techniques are studied to determine suitable methods for excavating rocks, like basalt, on the moon under lunar environmental conditions. Desired features are low weight, versatility, reliability, and efficiency. Areas considered are drilling, blasting, and rock moving. A down-the-hole, rotary-percussive tool appears to be the most suitable drill. Other possibilities are shaped charge, rotary, percussive, and shot drills. Chemical high-energy and nuclear explosives are examined for blasting effectiveness. Multiple hole placement of chemical explosives has considerable utility, while nuclear devices can excavate larger quantities of rock with less payload. Suitable rock-moving equipment includes cable-controlled dragline buckets, lightweight hoes, tractor-shovels, bulldozers or dozer-rippers, and conveyor belts. Author

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N65-20161*# Goodyear Aerospace Corp., Akron, Ohio.
PHOTOMETRIC MEASUREMENTS OF SURFACE CHARACTERISTICS OF ECHO I SATELLITE Final Report
Richard H. Emmons, Harvey E. Henjum, C. L. Rogers, and Darell C. Romick Washington, NASA, Apr. 1965 88 p refs (Contract NAS1-3114)
(NASA-CR-200) CFSTI: HC $3.00/MF $0.75

The results and techniques of a program that exploited the realistic test specimen represented by the nearly 4-year-old Echo I Satellite by measuring its present surface characteristics are described. For this purpose, the classical astronomical techniques of photometric measurement were employed by developing and utilizing equipment and procedures for the measurement of satellite-reflected light. The data obtained thereby were analyzed to derive and evaluate the desired characteristics. Changes in specularity, reflectance degradation, overall size, and present shape of the Echo I satellite are derived by this means. Data were taken during every satisfactory pass with suitable weather; results obtained from analysis of these data indicate that nearly all of the initial specularity remained, that reflectance decreased less than 10% over the 4-year period in the earth-orbital space environment, and that the mean diameter reduced very little although significant local surface variations were measured. Author

N65-20674# Royal Aircraft Establishment, Farnborough (England).
TABLE OF THE ARTIFICIAL EARTH SATELLITES LAUNCHED IN 1957–62
Janice M. Rees and D. G. King-Hele London, Min. of Aviation, Feb. 1963 43 p refs
(RAE-TN-SPACE-27)

A table is given of all known artificial satellites launched before January 1, 1963, with lifetimes, weights, dimensions, and details of the orbits, whenever known, for all instrumented satellites and their rockets. Other fragments from the satellites are listed without these details. The methods used in compiling the table and the difficulties encountered are outlined. Author

N65-20793*# Geophysics Corp. of America, Bedford, Mass. GCA Technology Div.
CANISTER FOR PRODUCING TMA TRAILS IN THE UPPER ATMOSPHERE
A. Corman and N. J. Guarino Feb. 1965 34 p (Contract NASw-1083)
(NASA-CR-57751; GCA-TR-65-2-N) CFSTI: HC $2.00/MF $0.50

A trimethylaluminum (TMA) payload canister was designed, built, and flight tested within a 10-week period. The first test flight, was completely successful. Release of the TMA was initiated as programed at 251 seconds after liftoff and a visible trail was generated. The canister design consists basically of a seamless teflon bladder which contains the TMA, a pressurizing source and explosively actuated valve with a flow-control orifice, a programer, and an external shell. Primary design features are high-expulsion efficiency, independence of vehicle motions, safe handling and storage, safe and reliable filling methods. Author

N65-20815*# National Aeronautics and Space Administration, Washington, D. C.
MARINER IV
[1965] 1 p
(NASA Facts, Vol. II, No. 9) GPO: $0.15

The National Aeronautics and Space Administration presents an outline of the unmanned Mariner IV spacecraft mission and design. This spacecraft was launched to provide the first close look at Mars and to accumulate engineering experience in operations of spacecraft during prolonged flights away from the sun. Its scientific instrumentation includes (1) an ionization chamber designed to measure the intensity of high-energy radiation with emphasis on cosmic rays; (2) a trapped radiation detector to report the possible existence of a radiation belt around Mars; (3) a cosmic ray telescope to analyze in detail portions of the cosmic-ray energy range covered by the ionization chamber; (4) a magnetometer to provide information on the strength and direction of magnetic fields in interplanetary space; (5) a micrometeoroid detector; (6) a solar plasma probe to measure parameters of the solar plasma between Earth and Mars; (7) an occultation experiment to observe the radio transmission behind the planet Mars; and (8) a television camera for closeups of the Martian surface. G.G.

N65-20875# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
METEOROLOGICAL ROCKET NETWORK FIRINGS. VOLUME XXXI: MARCH 1964 FIRINGS Data Report
Jan. 1965 204 p
(IRIG-109-62; AD-458863)

This report contains the wind and temperature measurements from all available network firings for March 1964. It also includes the radiosonde observations nearest the time of firing, provided they are within ±6 hours. The report does not include unsuccessful firings. The data included in this report were derived from a total of 90 rocketsonde observations. All altitudes are reported in meters and wind speeds in meters per second. The wind components are handled in accordance with the usual convention. None of the above parameters is reported above 65 kilometers due to the severe limitations imposed by the current measuring techniques. Author

N65-20881*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
DYNAMICS OF A ROTATING CYLINDRICAL SPACE STATION
Walter Krause Polstorff Washington, NASA, Apr. 1965 21 p refs
(NASA-TN-D-2749) CFSTI: HC $1.00/MF $0.50

Equations describing the reaction of a space vehicle to rotating machinery and to mass motion inside the vehicle are formulated. These equations include the angular impulse introduced by the moving mass. The dynamics of a cylindrical space station rotating around its major axis once every 10 seconds are evaluated numerically. The long cylinder provides the large distance between the axis of rotation and the crew compartment needed to generate comfortable artificial gravity; but the rotating cylinder is known to have little dynamic stability around its longitudinal axis. Nevertheless, the stability characteristics of this configuration are acceptable provided there is as little as 0.2% asymmetry between the major and intermediate moments of inertia. Detailed investigations performed on an analog computer show the effect of path and timing on the magnitude of the disturbance caused by a mass relocation. Also analyzed in some detail are ways to minimize roll. Author

N65-20941 Gt. Brit. Dept. of Scientific and Industrial Research. Radio Research Station
KINETHEODOLITE OBSERVATIONS OF SATELLITES RECEIVED BY THE PREDICTION SERVICE FROM MALTA: JULY 1964 (PART B), ISSUE 2
[1965] 57 p

Observations during July 1964 are reported for the 1962 Beta-Mu 2 (Anna 1B), 1962 Beta-Tau 6 (Injun 3), 1963-03A (Thor Agena D), 1963-30A (Midas 7), 1963-30D (Atlas Agena B), 1963-43A (Polyot 1 Sat), 1963-53A (Explorer 19), 1964-04A (Echo 2), and other unidentified satellites. E.E.B.

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N65-20271 Joint Publications Research Service, Washington, D. C.
ENGINEERING COMPUTATION OF OPTIMUM SHOCK ABSORPTION OF MEASURING MECHANISMS IN SHOCK-RESISTANT INSTRUMENTS
V. S. Novoselov *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 6, 1964 24 Mar. 1965 p 123–131 refs (See N65-20252 10-09) CFSTI: $5.00

Engineering computations of optimal shock absorption values for rubber-mounted measuring mechanisms in shock-resistant instruments, using flexible panels of any dimensions, are discussed. Solutions of two problems are given: first, the selection of shock-absorption for the measuring mechanism so that, under conditions of dynamic characteristics of shock tests, absolute longitudinal, transverse, and angular acceleration will not exceed specified values; second, the determination of maximum values for longitudinal, transverse, and angular acceleration for a given instrument. E.E.B.

N65-20272 Joint Publications Research Service, Washington, D. C.
DETERMINATION OF RIGIDITY COEFFICIENTS OF THE ELASTIC BASE OF A PIN JOINT
M. M. Dombrovskaya *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 6, 1964 24 Mar. 1965 p 132–141 refs (See N65-20252 10-09) CFSTI: $5.00

The article sets forth the calculations and experimental investigation of the rigidity of the elastic base of a shaft with a round cross section, in the presence of surface roughness at the points of contact. The problem arose in connection with a theoretical investigation of the rigidity of a pin joint, involving the pin and its sleeve. Author

N65-20347# General Technology Corp., Torrance, Calif.
CONICAL SHELLS WITH LINEARLY VARYING WALL THICKNESS
Huo-hsi Pan Sep. 1964 46 p refs
(Contract DA-11-022-ORD-2917)
(TR-1-21; AD-610032)

Equations are derived for determining stresses of a truncated right conical shell of varying thickness, thinner at one end and thicker at the other end. The load applied to the shell is a distributed load normal to the middle surface and acting over the entire surface. On the boundary, axially symmetric forces and moments may be prescribed, but these forces cannot be entirely arbitrary as the equilibrium along the direction of the cone axis must be observed. Deformations and stress–strain relationships are developed. E.E.B.

N65-20406*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
INVESTIGATION OF AIR DAMPING OF CIRCULAR AND RECTANGULAR PLATES, A CYLINDER, AND A SPHERE
David G. Stephens and Maurice A. Scavullo Washington, NASA, Apr. 1965 23 p refs
(NASA-TN-D-1865) CFSTI: HC $1.00/MF $0.50

An investigation was conducted to determine the mechanism of air damping exhibited by rigid bodies of different shapes oscillating in a pressure environment. Circular and rectangular plates, as well as a sphere and cylinder, were attached to cantilever springs and the free decay of an induced oscillation was measured at pressure levels from atmospheric to 4×10^{-2} torr. Data show the effect of pressure, vibratory amplitude, frequency, shape, and surface area on the air damping of the models. Results indicate that the magnitude of the air damping may greatly exceed the structural damping of the system. The air damping associated with the plates is directly proportional to the pressure and amplitude and indicative of dissipative loads proportional to the dynamic pressure. The plate damping was found independent of shape and is a nonlinear function of the surface area. The sphere and cylinder exhibit viscous damping characteristics in good agreement with available theory. Author

N65-20423*# Whittaker Corp., San Diego, Calif. Narmco Research and Development Div.
DESIGN AND FABRICATION AND DELIVERY OF FIBERGLASS BOX BEAM ASSEMBLY Final Report, 30 Jun. 1964–15 Mar. 1965
William H. Gottwald Mar. 1965 92 p
(Contract NAS8-11749)
(NASA-CR-57596) CFSTI: HC $3.00/MF $0.75

This report describes work on a program whose objective was to design and fabricate a fiber glass box beam to be tested and compared, by the National Aeronautics and Space Administration (NASA), with metallic box beams. A complete stress

analysis is presented which contains (1) a summary of the design loads, margins of safety for the shear webs and the top panel compression member and a theoretical weight analysis for the beam; (2) an analysis of the predicted failing load of NASA's aluminum box beam; (3) a basic stress analysis for the fiber glass reinforced box beam; and (4) a description of modifications in the basic design of the fiber glass reinforced box beam. In addition, this report describes results of tests performed on test specimens of the major load-carrying components. Fabrication details along with the materials and processing data used to construct the box beam are given, and quality assurance testing data are delineated. Author

N65-20475*# Astro Research Corp., Santa Barbara, Calif.
SOME DYNAMICS PROBLEMS ON INFLATION OF BUBBLES IN SPACE
Odus R. Burggraf Apr. 1965 59 p refs
(Contract NASw-652)
(NASA-CR-203) CFSTI: $3.00/MF $0.50

The concept of blowing large bubbles from a viscoelastic material was suggested as a means of constructing enclosures in space. The dynamics of the inflation of such bubbles are investigated by analyzing a variety of problems. The steady inflation of a spherical bubble is considered first, to determine the radius–time history of a spherical film subject to variable mass flux of pressurizing gas. A self-similar analysis of the gas motion is included. Acoustic oscillations of a bubble about its equilibrium state are considered next with an explicit formula derived for the frequency of the fundamental mode of oscillation. The limiting case of incompressible flow is considered, with the conclusion that it is valid only for thick-walled bubbles. Low frequency instabilities during inflation are considered last. After deriving the fluid dynamical equations, a quasi-steady approximation is carried out for thick-walled bubbles. Finally, the differential equation is derived for the perturbed motion of a thin-walled bubble as a generalization on the work of Plesset. By means of example the instabilities are shown to be related to the inflation history of the bubble. Author

N65-20485*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ANALYSIS OF HYPERVELOCITY PERFORATION OF A VISCO-PLASTIC SOLID INCLUDING THE EFFECTS OF TARGET-MATERIAL YIELD STRENGTH
Robert G. Thomson Washington, NASA, Apr. 1965 41 p refs
(NASA-TR-R-221) CFSTI: HC $2.00/MF $0.50

A visco-plastic flow theory for the solution of hypervelocity perforation of thin plates was investigated. A short-time analytical solution of the governing equation including the effects of yield strength of the target material was obtained and expressions were derived for the velocities, displacements, strains, and strain rates present in the target material during hypervelocity impact. In addition, pertinent parameters were varied and a comparison was made with the solution in which the yield strength was neglected. The results indicate that the velocities, displacements, and stresses determined from the present solution are at times markedly different from the results obtained when the yield strength is neglected. The effects on the radius of perforation of the plate material when the yield strength is included were found to be not as significant as those of the solution neglecting target yield strength, and to result in little variation in the computed perforation radii. Author

N65-20520# Don Bosco Inst. for Research, Ramsey, N. J.
THE EFFECT OF STRUCTURAL DAMPING ON THE FORCED VIBRATIONS OF CYLINDRICAL SANDWICH SHELLS
Irving W. Jones and V. L. Salerno Dec. 1964 42 p refs
(Contract Nonr-4199(00))
(DBIR-105; AD-612539)

This report presents an examination of the effects of structural damping on the axisymmetric forced vibrations of a cylindrical sandwich shell. The analysis is formulated by two methods, one exact but leading to lengthy calculations, the other simple, approximate, and requiring only a knowledge of the natural modes. In numerical examples, two steel-faced sandwich cylinders are compared. One has a polymeric, the other, an elastomeric core. The results indicate that under a time-harmonic radial pressure they are both effective for suppressing resonant vibration the polymeric core being generally more effective than the elastomeric. Author

N65-20525# Brown Univ., Providence, R. I. Div. of Applied Mathematics
A COMPLETE STRESS FUNCTION SOLUTION IN THE DYNAMIC LINEAR THEORY OF INCOMPRESSIBLE ELASTIC BODIES
George M. C. Fisher Feb. 1965 7 p ref
(Contract Nonr-562(10))
(C11-97; AD-611625)

Through a method of Somigliana, a complete stress-function solution and an associated displacement decomposition are given for the linearized theory of dynamic incompressible elasticity. Author

N65-20589# Institut Franco-Allemand de Recherches, St. Louis (France).
THE STUDY OF IMPACTS AT GREAT SPEED [ETUDE D'IMPACTS A GRANDE VITESSE]
C. Lecomte [1963] 51 p refs In FRENCH
(ISL-T-27/63)

Three aspects of high speed impact were studied: impacts in semi-infinite targets, impacts in thin targets, and shielding effectiveness of a thin foil in front of the target. Combinations of Dural aluminum and polyethylene projectiles and targets were used in investigating the influences of the projectile material and shape and also of the target material and thickness on the crater characteristics. The shielding effectiveness of polyethylene and Dural sheets of varying thicknesses placed at various distances in front of the target were also investigated. M.P.G.

N65-20620*# General Electric Co., King of Prussia, Pa. Space Sciences Lab.
EFFECT OF IMPACT VELOCITY ON THE PERFORMANCE OF SEVERAL ENERGY ABSORPTION MATERIALS
Anthony P. Coppa [1964] 25 p Prepared for JPL
(Contract NAS7-100)
(NASA-CR-57591) CFSTI: HC $4.00/MF $0.50

Specimens were mounted on a relatively massive fixture and impacted by a projectile. The fixture was free to move along the line of impact. Accelerometers were used for impact sensing and deceleration. The accelerometer and strain gage data were reduced to plots of the ratio of compressive stress to density vs unit axial shortening. Specific energy was plotted against impact velocity. The greatest effect of impact velocity on specific energy appeared beyond a velocity of 250 ft/sec. The performance of the fiber glass–plastic honeycomb appeared to degrade at the higher impact velocities while that of the aluminum honeycomb appeared to improve, showing an increase of 21% over static specific energy. The aluminum honeycomb can be used safely for high velocity impact energy absorption in its present off-the-shelf condition. The fiber glass–plastic honeycomb material tested requires improvement of interlaminate bond strength. E.P.V.

N65-20634# Royal Aircraft Establishment, Farnborough (England).
SOME HYDRODYNAMIC AND STRUCTURAL ASPECTS OF DESIGN FOR THE DITCHING OF LANDPLANES
A. G. Smith, D. C. Appleyard, R. J. Monaghan, and R. A. Weatherhead London, Min. of Supply, Nov. 1946 15 p refs
(RAE-TN-AERO-1848)

A study is made of possible behavior of a landplane in ditching. It is provisionally concluded that the landplane can be made to ditch satisfactorily at a cost in structure weight of the order of 0.4% to 0.8% of the all up weight, assuming the following conditions: (1) The touchdown should be made on the equivalent of calm water such that the rate of descent does not exceed about 3 fps nor the fuselage attitude about 6° to the water surface. (2) The aircraft should stick on the water and plane tail down at about 6° incidence until the nose sinks in at about half the touch down speed. (3) The fuselage bottom cross section should be rounded or vee-shaped so that the maximum deceleration at impact does not exceed 1 g downwards or 2 g forwards, the maximum mean pressures on the center and aft fuselage 20 lb/sq. inch and on the forward fuselage 12 lb/sq. inch. Author

N65-20643# Royal Aircraft Establishment, Farnborough (England).
THE ESTIMATION OF STRESSES AROUND UNREINFORCED HOLES IN INFINITE ELASTIC SHEETS
A. J. Sobey London, Min. of Aviation, Oct. 1962 28 p refs
(RAE-R-STRUCT-283)

A practical procedure for investigating the state of stress around an arbitrary doubly symmetric hole in infinite elastic sheets in tension and shear is presented. The associated problem of conformally mapping an arbitrary region onto the unit-circle is solved using an iterative technique. Author

N65-20644# Royal Aircraft Establishment, Farnborough (England).
THE VARIATION IN PERFORMANCE OF UNDERCARRIAGE SHOCK ABSORBERS
H. G. Spurr London, Min. of Supply, Oct. 1951 16 p refs
(RAE-TN-STRUCT-77)

The results are given of drop tests made to investigate the variation in performance of undercarriage shock absorbers. Twenty Spitfire undercarriages of two different types were used. An analysis is made of the variations in acceleration and shock-absorber closure under different conditions. These variations are shown to be wider between nominally identical undercarriages than between different drops of the same undercarriage. They increase when additional friction is caused by nonaxial loading. Author

N65-20740# Royal Aircraft Establishment, Farnborough (England).
THE CURE OF FLUTTER—A QUICK WAY OF INVESTIGATING THE EFFECT OF MODIFICATIONS
D. L. Woodcock London, Min. of Aviation, May 1964 17 p refs
(RAE-TN-STRUCT-358)

A method of determining the effect of small changes in a system on the flutter characteristics of the system is described. It uses expressions, here derived, for the rates of change of the eigenvalues with variations of the system. It is suggested that this may sometimes be the most convenient way of trying a large number of possible changes in order to find a cure for flutter. A mercury autocode digital computer program does this; its use is described, illustrated by an example. Author

N65-20759# Aeronautical Research Labs., Melbourne (Australia).
SOME EFFECTS OF THERMOELASTICITY IN THE THEORY OF GROUND RESONANCE TESTING
N. B. Joyce Apr. 1964 16 p refs
(ARL/SM-297)

A characteristic phase lag theory is developed for the ground resonance testing of a structure, extending to those cases when the damping is due to thermoelastic effects, or when the heat flow through the surface is controlled. A result is that the criterion for resonance is a phase lag greater than $\pi/2$ by an increment inversely dependent on frequency. This increment is measurable, being above the limit of phase discrimination of existing measuring equipment, for many beams. It is large for the flexible plate type of construction used for some dynamic models. Author

N65-20762# Budd Co., Philadelphia, Pa.
MANUFACTURE AND HYDROTEST OF THREE 20 INCH DIAMETER MAR-AGING STEEL PRESSURE VESSELS Final Technical Report, 16 May 1963–16 Oct. 1964
Walter J. Hauck [1964] 54 p
(Contract DA-36-034-ORD-3296)
(AD-610081)

The objective was to conduct a metallurgical evaluation of 18% nickel maraging steel and manufacture and hydrotest three 20-inch diameter pressure vessels made from 18% nickel maraging steel strip employing the helical weld design concept developed on the basic contract. The data obtained would provide a measure of reliability of the design and manufacturing process. A metallurgical evaluation was made to determine the physical properties obtainable in the 18% nickel maraging steel to be used in fabricating the rocket motor cases. The data resulting from this work establish the validity of the pressure vessel design concept wherein the high strength, inherent quality and other desirable properties of maraging steel strip are utilized. When the full properties of maraging steel strip are employed metal rocket cases can be fabricated reliably having yield strengths in excess of 300 000 psi. Author

N65-20935# Aberdeen Proving Ground, Md. Terminal Ballistics Lab.
A MODELING AND TESTING TECHNIQUE FOR DETERMINING THE STRUCTURAL RESPONSE OF AIR BLAST LOADED REINFORCED-CONCRETE STRUCTURES
Joseph F. Melichar Sep. 1964 69 p refs
(BRL-MR-1609; AD-460304)

The technique was experimentally attempted using as the blast load a step shock wave produced by a shock tube. The shock wave impinged on a one-fiftieth scale model, 90° central angle, spherical shell. Similitude relationships for the loading and response characteristics of the model were attained with only a single violation, which proved to be of negligible magnitude. The model shells were fabricated from a low-strength mortar with a high lime content. The material properties of the scaled mortar as compared to those of the prototype concrete are discussed, and the problem areas are outlined. Dynamic shell theory and the results from dynamic tests of the prototype shell were used to help evaluate the modeling and testing procedure. The technique described was found to be useful, but would require refinement to make it a research and design tool. Author

N65-20969*# Midwest Applied Science Corp., Lafayette, Ind.
STATISTICAL MODELS OF CUMULATIVE DAMAGE Final Report

Frank Kozin Dec. 1964 109 p refs *Its* Rept.-64-17
(Contract NAS8-11180)
(NASA-CR-57779) CFSTI: HC $4.00/MF $0.75

A cumulative damage theory dealing with the failure of specimens in fatigue is presented. The damage is treated as a random variable, and the average damage is related to the irreversible work input to the specimen. The theory is compared to other theories of fatigue failure. Recommendations for further work are presented. Author

N65-20995*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
TORSIONAL VIBRATION CHARACTERISTICS OF A 1/5-SCALE MODEL OF SATURN SA-1
John J. Catherine Washington, NASA, Apr. 1965 55 p refs
(NASA-TN-D-2745) CFSTI: HC $3.00/MF $0.50

The results of a torsional vibration test of a 1/5-scale model of the Saturn SA-1 launch vehicle supported by an eight-cable suspension system simulating a free-free boundary condition are presented herein. The vibration modes, frequencies, and damping were obtained at three weight conditions corresponding to different points in the launch trajectory. These conditions were 100, 48, and 0 percent of the booster propellant load at lift-off. Two values of stiffness of the eight-cable suspension system were employed at the 48-percent weight condition. The results presented cover the frequency range of 20 to 70 cps and show the unusual frequency spectrum and mode shapes of the Saturn vehicle which result from its clustered configuration. The first torsion mode and a variety of booster modes (modes in which the various outer tanks and engines of the booster stage move relative to each other) are presented. Comparisons, showing good agreement, of the model test results with results from both a full-scale torsional vibration test and a cursory analytical study are also presented. Author

N65-21029# IIT Research Inst., Chicago, Ill.
THE SIGNIFICANCE OF CONCENTRATED LOADS IN LIMIT ANALYSIS OF SHELLS
John A. De Runtz, Jr. and Philip G. Hodge, Jr. Dec. 1964 102 p refs
(Contract Nonr-1406(04))
(DOMIT-1-27; AD-612663)

The yield point load of a simply supported conical sandwich shell loaded at its vertex through a rigid central boss is found for a material obeying the Tresca yield condition. Exact solutions are found for a wide range of shell configurations ranging from thick shallow cones to thin steep ones and including large and small boss sizes. The results are compared with those for the limiting case of zero boss radius corresponding to a complete conical shell loaded with a concentrated load at its vertex. It is found that for thick shallow shells the concentrated load solution is a good approximation to the solution for realistically small boss sizes, but that for thin and/or steep shells the agreement is so poor as to make the concentrated load solution meaningless. Author

N65-21042# IIT Research Inst., Chicago, Ill. Dept. of Mechanics
MINIMUM VOLUME DESIGN OF AXISYMMETRIC PLATES: CLASSIFICATION OF PLATES AND STRESS VARIATION Interim Technical Report No. 1.1
George J. Megarefs Feb. 1965 38 p refs
(Contract DA-31-124-ARO(D)-185)
(DOMITT-4-1.1; AROD-4551-1; AD-458439)

This report lays the foundations for the development of a method for the minimum volume design of rigid ideally plastic axisymmetric plates employing exclusively statical means. This method is capable of supplying more detailed information and leading more directly to the desired minimum volume design than the standard method currently in use. A classification of axisymmetric plates according to their statical characteristics is introduced; an important property of one class of such plates is discussed. The notion of stress variation is presented; some types of stress variations especially useful in the development and application of the method, are constructed. Author

N65-21098# General Technology Corp., Elgin, Ill.
AN INVESTIGATION OF THE BENDING OF ROTATING TORSION-BAR SPRINGS
Severino Koh Aug. 1964 24 p refs
(Contract DA-11-022-AMC-168(A))
(TRX-2; AD-609921)

Equations are given for the elastic curve of a torsion spring rotating about its axis at constant angular velocity. One end is assumed fixed with respect to the timing mechanism, having zero transverse displacement and zero slope. The first boundary condition for the opposite end is unconstrained except for zero transverse displacement. The second boundary condition is zero slope and zero transverse displacement. The first three (high) critical angular velocities, at which bending occurs, are plotted for springs having representative rectangular and circular cross sections. The critical velocities are generally higher for first type boundary conditions than for the second type. For comparison of the cross sections, three cases are chosen, giving equal angles of twist per unit length for equal twisting moments. For the third case, the critical velocity of the square section is slightly higher than for the circular section, with the reverse situation obtaining for the first two cases. E.P.V.

N65-21103# General Dynamics/Astronautics, San Diego, Calif. Engineering Dept.
THERMAL STRESSES IN SANDWICH CYLINDERS
S. N. Dharmarajan, E. J. Kaminski, and M. Chirico 31 Dec. 1964 21 p refs
(GD/A-ERR-AN-529)

Based on small deflection theory, governing differential equations are derived for a sandwich cylindrical shell subjected to internal pressure and axisymmetric temperature gradient. The sandwich shell is assumed to have isotropic facings of unequal thickness and orthotropic core. Both the shear deformation and deformation along the shell normal are accounted for in the theory. Author

N65-21115# Joint Publications Research Service, Washington, D. C.
DAMPING OF OSCILLATIONS IN A SET OF BARS WITH WIRE AND TUBULAR FASTENING TIES
R. L. Zaydel'man 6 Apr. 1965 11 p refs Transl. into ENGLISH from Energomashinostr. (Moscow), no. 8, Aug. 1964 p 26-29
(JPRS-29458; TT-65-30664) CFSTI: $1.00

An analysis of the damping capability of sets of blades, broached with wires or fastened with tubular ties, was performed on six rectangular rod sets fastened with different variants of ties in a mandrel. Free damped oscillations through deflection of the rods from a position of balance were studied, by using the dependence on the stresses of the rods near their base, and the mean stresses in the volume of the rod with two different ratios of rigidity of ties to the rigidity of rods.

It was concluded that (1) sets of blades with tubular fastening ties indicate a higher damping capability; (2) two tubular ties, one of which is situated near the center of the rod, showed maximum increase in the oscillation decrement; and (3) the use of three tubular ties leads to a perceptible decrease in the damping capability of sets as compared with two ties. G.G.

N65-21116# Hydronautics, Inc., Laurel, Md.
ON THE FLEXIBLE-FLAP DAMPER FOR AIR-CUSHION VEHICLES
C. C. Hsu May 1964 29 p refs
(Contract NObs-88272)
(TR-347-1; AD-454969)

An approximate analysis of the general dynamic characteristics of a two-dimensional air-cushion craft with hinged flexible flaps, employing lumped-parameter assumptions, is made. The free oscillation system is, in general, stable. With the proper selection of inertia stiffness, flap damping, and geometrical configuration, the flexible flap may effectively be used as a forced motion damper. Author

N65-21132# Lockheed Missiles and Space Co., Sunnyvale, Calif.
SOLID MECHANICS: BUCKLING OF ORTHOTROPIC CYLINDERS UNDER AXIAL COMPRESSION
B. O. Almroth Jun. 1963 55 p refs
(LMSC-6-90-63-65; AD-610267)

Previously derived equations for the buckling of axially loaded orthotropic cylinders are reviewed, and solutions to the equations given. An analysis of the postbuckling behavior is also performed, and the applicability of the classical theory discussed in the light of the results of that analysis. Finally, a practical method of analysis is suggested, and the buckling load determined by this method is compared with available test data. Author

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N65-20151# Oak Ridge National Lab., Tenn. Instrumentation and Controls Div.
SMOOTHED THERMOCOUPLE TABLES OF EXTENDED SIGNIFICANCE (°C). VOLUME 2, SECTION 2.6: CHROMEL-CONSTANTAN THERMOCOUPLES
R. K. Adams and E. G. Davisson Mar. 1965 39 p refs
(Contract W-7405-ENG-26)
(ORNL-36-49, Vol. 2, Sect. 2.6) CFSTI: $2.00

Tabulations are given of smoothed emf (in absolute millivolts) vs temperature and of emf differences for chromel–constantan thermocouples. A figure shows the microvolt difference between smoothed and reference values of emf. E.P.V.

N65-20152# Oak Ridge National Lab., Tenn. Instrumentation and Controls Div.
SMOOTHED THERMOCOUPLE TABLES OF EXTENDED SIGNIFICANCE (°C). VOLUME 2, SECTION 2.7: TUNGSTEN VS TUNGSTEN–26% RHENIUM THERMOCOUPLES
R. K. Adams and E. G. Davisson Mar. 1965 70 p refs
(Contract W-7405-ENG-26)
(ORNL-3649, Vol. 2, Sect. 2.7) CFSTI: $3.00

Tabulations are given of smoothed emf (in absolute millivolts) vs temperature and of emf differences for tungsten vs tungsten–26% rhenium thermocouples. A figure shows the microvolt difference between smoothed and reference values of emf. E.P.V.

N65-20153# Oak Ridge National Lab., Tenn. Instrumentation and Controls Div.
SMOOTHED THERMOCOUPLE TABLES OF EXTENDED SIGNIFICANCE (°C). VOLUME 2, SECTION 2.8: TUNGSTEN–5% RHENIUM VS TUNGSTEN–26% RHENIUM THERMOCOUPLES
R. K. Adams and E. G. Davisson Mar. 1965 69 p refs
(Contract W-7405-ENG-26)
(ORNL-3649, Vol. 2, Sect. 2.8) CFSTI: $3.00

Tabulations are given of smoothed emf (in absolute millivolts) vs temperature and of emf differences for tungsten–5% rhenium vs tungsten–26% rhenium thermocouples. A figure shows the microvolt difference between smoothed and reference values of emf. E.P.V.

N65-20154# Oak Ridge National Lab., Tenn. Instrumentation and Controls Div.
SMOOTHED THERMOCOUPLE TABLES OF EXTENDED SIGNIFICANCE (°C). VOLUME 2, SECTION 2.9: TUNGSTEN–3% RHENIUM VS TUNGSTEN–25% RHENIUM THERMOCOUPLES
R. K. Adams and E. G. Davisson Mar. 1965 70 p refs
(Contract W-7405-ENG-26)
(ORNL-3649, Vol. 2, Sect. 2.9) CFSTI: $3.00

Tabulations are given of smoothed emf (in absolute millivolts) vs temperature and of emf differences for tungsten–3% rhenium vs tungsten–25% rhenium thermocouples. A figure shows the microvolt difference between smoothed and reference values of emf. E.P.V.

N65-20155# Oak Ridge National Lab., Tenn. Instrumentation and Controls Div.
SMOOTHED THERMOCOUPLE TABLES OF EXTENDED SIGNIFICANCE (°C). VOLUME 2, SECTION 2.10: GOLD—2.1% COBALT VS COPPER CRYOGENIC THERMOCOUPLES
R. K. Adams and E. G. Davisson Mar. 1965 16 p refs
(Contract W-7405-ENG-26)
(ORNL-3649, Vol. 2, Sect. 2.10) CFSTI: $1.00

Tabulations are given of smoothed emf (in absolute millivolts) vs temperature and of emf differences for gold–2.1% cobalt vs copper cryogenic thermocouples. A figure shows the microvolt difference between smoothed and reference values of emf. E.P.V.

N65-20156# Oak Ridge National Lab., Tenn. Instrumentation and Controls Div.
SMOOTHED THERMOCOUPLE TABLES OF EXTENDED SIGNIFICANCE (°C). VOLUME 2, SECTION 2.11: CONSTANTAN–COPPER CRYOGENIC THERMOCOUPLES
R. K. Adams and E. G. Davisson Mar. 1965 16 p refs
(Contract W-7405-ENG-26)
(ORNL-3649, Vol. 2, Sect. 2.11) CFSTI: $1.00

Tabulations are given of smoothed emf (in absolute millivolts) vs temperature and of emf differences for constantan–copper cryogenic thermocouples. A figure shows the microvolt difference between smoothed and reference values of emf.
E.P.V.

N65-20157# Oak Ridge National Lab., Tenn. Instrumentation and Controls Div.
SMOOTHED THERMOCOUPLE TABLES OF EXTENDED SIGNIFICANCE (°C). VOLUME 2, SECTION 2.12: ALUMEL-CHROMEL CRYOGENIC THERMOCOUPLES
R. K. Adams and E. G. Davisson Mar. 1965 15 p refs
(Contract W-7405-ENG-26)
(ORNL-3649, Vol. 2, Sect. 2.12) CFSTI: $1.00

Tabulations are given of smoothed emf (in absolute millivolts) vs temperature and of emf differences for alumel–chromel cryogenic thermocouples. A figure shows the microvolt difference between smoothed and reference values of emf.
E.P.V.

N65-20158# Oak Ridge National Lab., Tenn. Instrumentation and Controls Div.
SMOOTHED THERMOCOUPLE TABLES OF EXTENDED SIGNIFICANCE (°C). VOLUME 2, SECTION 2.13: CONSTANTAN (JN)–IRON (JP) CRYOGENIC THERMOCOUPLES
R. K. Adams and E. G. Davisson Mar. 1965 15 p refs
(Contract W-7405-ENG-26)
(ORNL-3649, Vol. 2, Sect. 2.13) CFSTI: $1.00

Tabulations are given of smoothed emf (in absolute millivolts) vs temperature and of emf differences for constantan (JN)–iron (JP) cryogenic thermocouples. A figure shows the microvolt difference between smoothed and reference values of emf.
E.P.V.

N65-20159# Oak Ridge National Lab., Tenn. Instrumentation and Controls Div.
SMOOTHED THERMOCOUPLE TABLES OF EXTENDED SIGNIFICANCE (°C). VOLUME 2, SECTION 2.14: CONSTANTAN (YN)–IRON (YP) CRYOGENIC THERMOCOUPLES
R. K. Adams and E. G. Davisson Mar. 1965 15 p refs
(Contract W-7405-ENG-26)
(ORNL-3649, Vol. 2, Sect. 2.14) CFSTI: $1.00

Tabulations are given of smoothed emf (in absolute millivolts) vs temperature and of emf differences for constantan (YN)–iron (YP) cryogenic thermocouples. A figure shows the microvolt difference between smoothed and reference values of emf.
E.P.V.

N65-20243# General Dynamics/Astronautics, San Diego, Calif. Space Science Lab.
CO-OXIDATION. II: INFLUENCE OF H_2 ON THE INDUCTION PERIOD PRECEDING RAPID CO_2-FORMATION IN SHOCK HEATED CO-O_2-Ar MIXTURES
K. G. P. Sulzmann, B. F. Myers, and E. R. Bartle Nov. 1964 29 p refs
(Contract DA-04-495-ORD-3383(Z); ARPA Order-393; Proj. Defender)
(GDA-DBE-64-062; AD-454936)

The influence of small amount of hydrogen on the induction period, τ_i, preceding rapid CO-oxidation in argon diluted CO-O_2-mixtures, has been studied at temperatures between 1500° and 3300° K and at pressures between 0.4 and 1.6 atm behind incident shock waves. For constant temperature and hydrogen concentration, τ_i is inversely proportional to the square roots of the initial mole concentrations of CO and O_2. The induction period is generally decreased with increasing amounts of hydrogen present, however, above 2400° K for an initial hydrogen concentration of 0.011% this effect becomes negligible. Under the latter conditions, the dependence on temperature of τ_i can be represented by an apparent activation energy of 40 kcal/mole (±10%). It is demonstrated that a modified Haber–Semenov mechanism can account qualitatively for the observed dependence on hydrogen of the induction period.
Author

N65-20349# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering
THE EFFECT OF AN ELECTRIC FIELD ON HEAT TRANSFER FROM A VERTICAL PLATE IN VARIOUS GASES OVER A RANGE OF PRESSURES
Richard James O'Brian (M.S. Thesis) Aug. 1964 104 p refs
(GA/ME/64-3; AD-610174)

This investigation studied the effect of electric field on heat-transfer rate from a vertical flat plate in air, nitrogen, and carbon dioxide over a range of pressures. Equipment was designed and tests were performed with a Mach–Zehnder-type interferometer to obtain basic data on the effect of pressure on heat-transfer coefficient at constant electrode-to-plate currents for vertical stations along the plate in air, nitrogen, and carbon dioxide. The accuracy of the empirical equation relating heat-transfer rate as linear functions of pressure and electrode-to-plate power was checked by eliminating pressure as a parameter in the equation and plotting all of the data points obtained on one graph of heat-transfer rate versus electrode-to-plate power. A dimensionless plot is presented of Nusselt number versus the product of the Prandtl and Grashof numbers showing the effect of pressure on heat-transfer coefficient at constant electrode-to-plate current.
Author

N65-20351# Purdue Univ., Lafayette, Ind. Jet Propulsion Center
1964 REVIEW OF RESEARCH
[1964] 348 p refs Meeting held at Jet Propulsion Center, Purdue Univ., 10–11 Dec. 1964
(JPC-396; TM-65-1)

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17. HIGH PRESSURE RESEARCH R. L. Strickler p 285–304 (See N65-20368 10-33)

18. A PARAMETRIC STUDY OF GAS-PARTICLE FLOWS IN CONICAL NOZZLES J. D. Hoffman p 305–329 refs (See N65-20369 10-33)

19. SECONDARY INJECTION OF GASES INTO A SUPERSONIC FLOW R. D. Guhse p 331–354 refs (See N65-20370 10-28)

N65-20352 Purdue Univ., Lafayette, Ind. Jet Propulsion Center

HEAT TRANSFER TO A GAS BUBBLING THROUGH A LIQUID

M. R. l'Ecuyer *In its* 1964 Rev. of Res. [1964] p 1–19 refs (See N65-20351 10-33)

(Grant NsG-140-61)

The energy transfer from a liquid to a gas bubbling through the liquid and the variables that govern such energy transfer during the direct contact of two immiscible fluids were investigated. The results indicate that (1) for an overall temperature difference between the liquid and the incoming gas of ~300° F, energy transfer during the formation period of a bubble can produce an increase in the temperature of the gas of 55% to 90% of the overall temperature difference; (2) the value of the average heat transfer coefficient for the entire bubble formation period varies from 18 to 39 B/hr-ft^2-F; (3) this variation depends on the mean mass velocity of gas flow into the bubble and the mean bubble diameter; and (4) the average heat transfer coefficient throughout the entire formation period can be used to analytically predict the rate of growth of a bubble and the change in gas temperature during bubble formation. M.P.G.

N65-20353 Purdue Univ., Lafayette, Ind. Jet Propulsion Center

ANALYTICAL AND EXPERIMENTAL INVESTIGATION OF FILM COOLING IN ROCKET NOZZLES

C. F. Warner, R. A. Gater, and D. L. Crabtree *In its* 1964 Rev. of Res. [1964] p 21–41 (See N65-20351 10-33)

(Contract Nonr-1100(21))

A theoretical analysis of the problem of heat transfer from a turbulent compressible flow to a film cooled wall in the presence of a favorable pressure gradient is proceeding together with experimental measurements in the boundary layers occurring in film cooled nozzles to obtain a fundamental understanding of the phenomena involved. The analytical phase has progressed to the point of establishing the feasibility of the similarity method of analysis. In the experimental phase, the gas generator system is fully operative, the first test section with its supporting photographic equipment and pressure gradient control mechanism has been run under cold flow conditions, and diagnostic tests to determine the regimes of stability of the liquid film are in progress. M.P.G.

N65-20354 Purdue Univ., Lafayette, Ind. Jet Propulsion Center

MASS TRANSFER IN ANNULAR, TWO-PHASE FLOW

G. R. Schneiter and R. S. Mezey *In its* 1964 Rev. of Res. [1964] p 43–62 refs (See N65-20351 10-33)

(Grant NSF G-21976)

The influences of gas flow rate, liquid flow rate, gas temperature, and tube length on mass transfer and gas phase pressure drop were investigated using an air–water system. The results indicate that (1) the Sherwood number is primarily influenced by the Reynolds number of the gas phase and increases with increasing gas Reynolds number; (2) the mass transfer rate increases slightly with increasing liquid Reynolds number, which may be attributed to increased roughness of the gas–liquid interface; (3) both the Sherwood number and the friction coefficient decrease with tube length, approaching a constant value for long tubes; and (4) mass transfer data can be satisfactorily correlated by a single equation for each tube length, independently of gas temperature. An optical system to measure the instantaneous film thickness as a function of time at one location along the tube is being developed in an attempt to relate gas–liquid interface characteristics to the mass transfer rates. M.P.G.

N65-20355 Purdue Univ., Lafayette, Ind. Jet Propulsion Center

STUDY OF COMBUSTION PRESSURE OSCILLATIONS IN BIPHASE PROPELLANT SYSTEMS

D. W. Netzer *In its* 1964 Rev. of Res. [1964] p 63–69 (See N65-20351 10-33)

(Grant AF-AFOSR-753-65)

Studies to determine rocket motor operating conditions which, when exceeded, result in the initiation of combustion pressure oscillations are reported. The problem was reduced to varying the injector pattern in an essentially fixed combustion chamber geometry, using a liquid fuel (gasoline)–gaseous oxidizer (air) system. The location of the combustion zone was found to move closer to the injector face with increasing chamber pressure, decreasing air injection velocity, or mixture ratios closest to the stoichiometric mixture ratio. A method for measuring combustion temperature profiles using a water-cooled temperature probe was developed as a result of these investigations. In this method, the gas temperature is calculated from the change in temperature of the cooling water circulated through the probe. Preparations for experiments employing contraction ratios and injector patterns similar to those now used in industry are also described. M.P.G.

N65-20356 Purdue Univ., Lafayette, Ind. Jet Propulsion Center

ATTENUATION OF TRANSVERSE COMBUSTION PRESSURE OSCILLATIONS

J. W. Converse *In its* 1964 Rev. of Res. [1964] p 71–85 (See N65-20351 10-33)

(Grant NsG-592)

The use of injector face baffles as acoustic damping devices to combat radial and tangential transverse pressure waves in combustion chambers of large liquid rocket engines is reviewed. The propagation modes of these waves and the geometry of baffle configurations are discussed. Two hypotheses are presented: (1) that the wave equation is capable of predicting the form and natural frequency of transverse acoustic waves in baffle geometries which constitute natural boundaries in an r, coordinate system; and (2) that transverse mode combustion pressure oscillations in an unstable rocket motor can be reduced to acceptable levels by the systematic application of these simple baffles. Analytical and experimental programs to verify these hypotheses are being undertaken in an attempt to develop frequency scaling laws for systematic baffle development. M.P.G.

N65-20357 Purdue Univ., Lafayette, Ind. Jet Propulsion Center

THE INTERACTION OF A FINITE AMPLITUDE PRESSURE PULSE WITH THE COMBUSTION REGION OF A ROCKET MOTOR

G. M. Lehmann *In its* 1964 Rev. of Res. [1964] p 87–109 refs (See N65-20351 10-33)

(Grant NsG-592; Contract Nonr-1100(21))

The variation of the strength of a weak shock-like discontinuity during its interaction with the combustion region in a rocket motor is considered. The case of the end-burning solid propellant motor is analyzed, but the method is also applicable to gaseous and liquid motors. The physical model used considers the rocket motor as divided into the propellant grain region, the combustion region, the combustion products region, and the nozzle region. The combustion region is further differentiated into decomposition, induction, and flame zones whose steady-state characteristics are defined. A finite amplitude pressure pulse (normal shock) is assumed to be propagating forward for the products region to interact with the flame zone, induction zone, and decomposition zone before it impinges on the burning surface of the solid propellant. The shock reflected from the burning surface is also considered. Preliminary results of a computer analysis of propagation of the incident shock through the flame zone indicate that diffusion has a negligible effect, bulk viscosity exerts only a minor effect, heat addition by chemical reaction amplifies the shock, and heat transfer may either attenuate or amplify the shock. M.P.G.

N65-20358 Purdue Univ., Lafayette, Ind. Jet Propulsion Center

GENERAL PROBLEMS IN COMBUSTION PRESSURE OSCILLATIONS IN CHEMICAL ROCKET (LIQUID PROPELLANT MOTORS)

S. N. B. Murthy *In its* 1964 Rev. of Res. [1964] p 111–120 (See N65-20351 10-33)

Following a review of the general problem of combustion vibration and its nature and causes, two theoretical models are proposed for analyzing combustion vibration. The first model refers to the relaxation interaction of an acoustic pressure wave with the combustion zone, and considers the interaction processes as based entirely on gas dynamic processes without any chemical relaxation times. The second model describes the flow configuration in the motor in a cylindrical coordinate system without making the assumption of axisymmetry. A transverse or longitudinal mode disturbance is introduced into the system, and equations governing the acoustic admittance are applied. The dimensionless groups of parameters of significance to such an analysis are discussed. Based on a set of experimental results obtained from several hundred laboratory motor firings, the similarity parameters of significance in a symmetry-governed disturbance in the tangential mode were found to be the Reynolds number of the propellants and the ratio of energy dissipation to energy generation. Organized testing and scaling of motors seems possible on the basis of analytical results using these models. M.P.G.

N65-20359 Purdue Univ., Lafayette, Ind. Jet Propulsion Center

HYBRID COMBUSTION

B. A. Reese *In its* 1964 Rev. of Res. [1964] p 121–139 refs (See N65-20351 10-33)

(Contracts N123(60530)29155A; N123(60530)34745A)

The effects of combustion products on the burning rate of solid fuels were investigated, using Plexiglas and hydrazine gel as the fuels and oxygen diluted with carbon dioxide, nitrogen, or helium as a premixed oxidizer in both impinging jet and parallel flow combustion systems. The experimental results were compared to those predicted by a model for the combustion of hybrid fuels adapted from theoretical studies of ablation with combustion. A satisfactory correlation was found only when absorption of heat by the diluent gas was considered in the heat required for vaporization of the fuel. Experimental results for laminar flow show that the burning rate of the solid fuel is reduced as the amount of diluent in the oxidizer is increased and as the specific heat of the diluent is increased. In turbulent flow or in chemically controlled reactions, the burning rate is also reduced with addition of diluent, but the effect of the specific heat of the diluent is not a linear function. The effect of adding a diluent is nearly independent of type of flow and of the fuel. Burning rate data are influenced considerably by the type of experimental system used to obtain the data. M.P.G.

N65-20360 Purdue Univ., Lafayette, Ind. Jet Propulsion Center

CONTINUOUS MEASUREMENT OF SOLID PROPELLANT BURNING RATES UNDER SIMULATED MOTOR CONDITIONS

R. J. Burick *In its* 1964 Rev. of Res. [1964] p 141–153 refs (See N65-20351 10-33)

(Grant AF-AFOSR-207-64)

An experimental system for the direct and continuous measurement of solid propellant burning rates is described. The system involves a servomechanism for accurately positioning the burning surface of a propellant sample which is located within a test rocket motor. Since the burning surface is maintained at a fixed position with respect to the test rocket motor, the direct measurement of the velocity of the propellant feed mechanism yields the burning rate of the propellant. At present, the fabrication of the servomechanism has been completed, burning rate data for nonerosive conditions have been obtained, and the erosive burning rate apparatus is being designed. M.P.G.

N65-20361 Purdue Univ., Lafayette, Ind. Jet Propulsion Center

FEASIBILITY STUDY OF A MICROWAVE METHOD AND AN ULTRASONIC METHOD FOR CONTINUOUS MEASUREMENT OF THE BURNING RATE OF SOLID ROCKET PROPELLANTS

P. Y. Ho *In its* 1964 Rev. of Res. [1964] p 155–161 (See N65-20351 10-33)

(Grant AF-AFOSR-207-64)

Two methods of obtaining continuous measurement of solid propellant burning rates are under consideration. The

operating principle of the microwave record is to pass a beam of microwaves (30 000 to 300 000 Mc/sec) through a dielectric material window in the motor and to measure the change of effective intensity of the received beam as a function of the position of the movable propellant sample within the test rocket motor. As the burning propellant surface recedes, the intensity of the received beam increases, providing a feedback signal to a servomechanism. The operating principle of the ultrasonic pulse-echo technique involves display by an oscilloscope of the input pulse, the echo pulse, and the time lapse between the two pulses. The thickness of the propellant is then calculated from the propagation velocity of the ultrasonic wave. The technique also provides feedback for a positioning servomechanism. Advantages and disadvantages of each method are listed, and a comparison of the two methods shows the ultrasonic pulse-echo method to be superior to the microwave method. M.P.G.

N65-20362 Purdue Univ., Lafayette, Ind. Jet Propulsion Center

TEMPERATURE PROFILE MEASUREMENT ABOVE A BURNING SOLID PROPELLANT

R. L. Derr *In its* 1964 Rev. of Res. [1964] p 163–181 (See N65-20351 10-33)

(Grant NsG-592)

The capability requirements for a temperature profile measuring apparatus are discussed, and the design of a system to satisfy these requirements is presented. The requirements are the capability of (1) rapidly measuring temperatures in the range 300° to 2500° K, (2) measuring the gas temperature over a very small flame cross section, (3) determining if the flame is in thermal equilibrium at the point of temperature measurement, (4) accurately measuring the distance from the point of temperature measurement to the burning surface of the propellant, and (5) maintaining the burning surface of the propellant stationary. The system which evolved consists of a modified line reversal pyrometer combined with a servocontrolled propellant feed shaft that maintains the burning surface in a somewhat fixed position relative to the temperature measuring point. A restricted salting of the propellant with metals to color the flame will permit the second and third requirements to be met using this system. Assembly and checkout of the apparatus is proceeding. M.P.G.

N65-20363 Purdue Univ., Lafayette, Ind. Jet Propulsion Center

MEASUREMENT ON THE SURFACE TEMPERATURE OF BURNING AMMONIUM PERCHLORATE

N. E. James *In its* 1964 Rev. of Res. [1964] p 183–200 refs (See N65-20351 10-33)

The relationship between the burning rate and the surface temperature of ammonium perchlorate is being investigated to elucidate the combustion mechanism of composite propellants. The burning rate parameters to be varied are the combustion pressure and the ammonium perchlorate particle size. Optical or infrared emission techniques will be used to measure surface temperatures. Problems posed by gas phase emission, transparency of the ammonium perchlorate, and the subsurface temperature gradient are discussed. A two-wavelength type of analysis of the surface emission is proposed to overcome the subsurface temperature gradient problem. M.P.G.

N65-20364 Purdue Univ., Lafayette, Ind. Jet Propulsion Center

A DETERMINATION OF THE EFFECTS OF ROTATION ON SPIN STABILIZED ROCKET MOTORS

B. W. Farquhar *In its* 1964 Rev. of Res. [1964] p 201–211 refs (See N65-20351 10-33)

(Contract DA-01-021-AMC-428(Z))

A spin test rig has been designed to study the effect of high angular velocities on the combustion process of solid propellants, the change in shape of the burning surface of solid propellant rockets because of large radial accelerations, and the influence of rotation of the rocket motor on the internal flow of gases. The rig design chosen allows the rocket motor to be mounted horizontally between bearings. The rocket casing will be mounted on bearings at the nozzle and at a shaft extending from the rear of the casing. The cold flow rocket motor will be 24 in. long with a 6 in. inner diameter which, at 30 000 rpm, will yield an acceleration of 70 000 g's at the interior wall. An air feed assembly will complete the rotating assembly. Inserts to simulate various grain configurations will be fabricated so that the "burning surface" location may be varied within the cylinder, and nozzle diameters of 1.2, 2.0, and 2.4 in. will be used in cold flow studies of vortex formations and back flow occurrence. Associated instrumentation is also described. M.P.G.

N65-20366 Purdue Univ., Lafayette, Ind. Jet Propulsion Center

ON A PARAMETRIC ANALYSIS OF THE DESIGN OF A TUBE ARC HEATER

D. J. Norton *In its* 1964 Rev. of Res. [1964] p 237–256 refs (See N65-20351 10-33)

(Contract AF 33(657)-10933)

A set of comprehensive design charts for use in the preliminary design of tube arc heaters operating exclusively in the inlet flow regime have been generated. These charts were developed as a simplification of an elaborate theory developed earlier. Using the charts, information may be obtained regarding the length and radius of a tube which attains a given power level, and the energy required to operate the tube at a prescribed level. M.P.G.

N65-20368 Purdue Univ., Lafayette, Ind. Jet Propulsion Center

HIGH PRESSURE RESEARCH

R. L. Strickler *In its* 1964 Rev. of Res. [1964] p 285–304 (See N65-20351 10-33)

(Grant NsG-592; Contract Nonr-1100(21))

The design of a combustion research facility to be used for investigations of high chamber pressure combustion phenomena, heat transfer characteristics, and novel design concepts is discussed. Four high pressure research programs that will be conducted using the facility are (1) analysis of heat transfer coefficients and combustion pressures, film and transpiration cooling, and maximum chamber pressure level; (2) investigation of uncooled chamber and injector concepts; (3) design of a water cooled chamber with film and transpiration cooling inserts; and (4) analysis of test results. The layout of the test cell facility building is discussed. M.P.G.

N65-20369 Purdue Univ., Lafayette, Ind. Jet Propulsion Center

A PARAMETRIC STUDY OF GAS-PARTICLE FLOW IN CONICAL NOZZLES

J. D. Hoffman *In its* 1964 Rev. of Res. [1964] p 305–329 refs (See N65-20351 10-33)

(Contract AF 04(694)-258)

Nonequilibrium flow effects associated with particle drag and heat transfer when powdered metal additives are used in propellant formulations were investigated. The analytical model used is discussed, and the numerical results obtained when the

following parameters were varied are presented graphically: particle diameter, flow rate ratio, nozzle divergence angle, nozzle expansion ratio, nozzle throat radius, throat upstream radius of curvature, and throat downstream radius of curvature. The data presented are representative of the effects encountered in conical nozzle flows, since the general trends were the same when different inlet and throat geometries were investigated. Therefore, these data should provide a reasonable estimate of the effect of various gas dynamic and geometrical parameters on the specific impulse delivered by the throat nozzle. M.P.G.

N65-20402*# AVCO-Everett Research Lab., Everett, Mass.
HEAT TRANSFER MEASUREMENTS IN PARTIALLY IONIZED GASES
P. H. Rose and J. O. Stankevics Washington, NASA, Apr. 1965 52 p refs
(Contract NASw-748)
(NASA-CR-204) CFSTI: HC $2.00/MF $0.50

An analysis is presented which demonstrates the response required of the measurement to enable accurate heat-transfer measurements to be made within the limited test times available. The difficulties of adapting the gage to the requirements are described, in particular the sensitivity, opacity, and adherence of the gage to the MgO window. The calibration of the absolute magnitude of the output of the infrared cell, as well as the response time of the measuring system, is described in detail. The response of the gage to the heat transfer encountered in both the shock tube end wall and on a model is discussed with emphasis on the identification of radiative heat transfer effects. Variations of the gage surface material achieved by overcoating the carbon with thin metallic films did not change the heat transfer rates measured. In view of the fact that the metallic films used do not change the calibration of the gage this is felt to be a conclusive result regarding the effect of surface materials. Author

N65-20403*# AVCO-Everett Research Lab., Everett, Mass.
NONEQUILIBRIUM SHOCK FRONT ROTATIONAL, VIBRATIONAL AND ELECTRONIC TEMPERATURE MEASUREMENTS
R. A. Allen Washington, NASA, Apr. 1965 27 p refs
(Contract NASw-748)
(NASA-CR-205) CFSTI: HC $2.00/MF $0.50

A spectroscopic technique is described for measuring nonequilibrium shock-front rotational, vibrational, and electronic temperatures. This method uses a triple channel monochromator which is able to resolve the vibrational structure of diatomic molecular radiation, and a monitor channel to observe an electronic transition composed of many vibrational transitions. Measurements are made on incident nitrogen shock waves by observing the $\Delta v = +1$ sequence of the $N_2^+(1-)$ and $N_2(1+)$ systems. As well as giving nonequilibrium temperature results, this experiment has given equilibrium radiation intensities which indicate an f number at the 0, 0 transition of 0.035. Author

N65-20404*# United Aircraft Corp., East Hartford, Conn.
THEORETICAL INVESTIGATION OF THE ABSORPTION AND SCATTERING CHARACTERISTICS OF SMALL PARTICLES
N. L. Krascella Washington, NASA, Apr. 1965 60 p refs
(Contract NASw-847)
(NASA-CR-210) CFSTI: HC $3.00/MF $0.50

A theoretical investigation was conducted to determine the absorption, scattering, and extinction characteristics of small solid spherical particles which might be employed as seeding agents to control radiant heat transfer in gaseous nuclear rocket engines. The calculations were made using the Mie theory to determine the effect of particle size, wavelength, and particle temperature on particle opacity in those regions of the ultraviolet, visible, and infrared spectra for which complex index of refraction information was available. The following materials were considered: aluminum, carbon, cobalt, iridium, molybdenum, niobium, palladium, platinum, rhenium, rhodium, silicon, tantalum, titanium, tungsten, and vanadium. Author

N65-20430 Douglas Aircraft Co., Inc., Santa Monica, Calif. Aerophysics Lab.
TURBULENT HEAT TRANSFER AND PRESSURE DISTRIBUTIONS ON A SPHERE-CONE-CYLINDER-FLARE CONFIGURATION AT MACH NUMBERS 2, 4, 6, AND 8
D. A. Sowers and D. D. Colosimo *In its* Results of Res. and Develop. Studies by the Douglas Aerophys. Lab. Staff during Fiscal Yr. 1963 Jan. 1964 56 p refs (See N65-20429 10-12) (SM-43056-2)

Experimental pressure and heat-transfer data have been obtained for a sphere–cone–cylinder–flare model at nominal Mach numbers of 2, 4, 6, and 8 at zero degrees angle of attack. The pressure data are shown to correlate with the modified Newtonian flow theory. The heat-transfer data are compared to the turbulent heat-transfer theory of Vaglio–Laurin and to the flat-plate-reference-enthalpy theory. The data are in close agreement with the predictions of the Vaglio–Laurin theory. The reference enthalpy theory, however, predicts the level of the turbulent heat transfer only over the sphere–cone portion of the model. For the cylinder–flare part of the model, the reference enthalpy theory is consistently higher than the data by as much as a factor of six. Stagnation point heat-transfer data are consistently higher than predicted by the stagnation point heat-transfer theory of Fay and Riddell, possibly due to the proximity of the boundary-layer transition. Author

N65-20452# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station
CALCULATION OF THE VAPOR PRESSURE AND HEATS OF VAPORIZATON AND SUBLIMATION OF LIQUIDS AND SOLIDS BELOW ONE ATMOSPHERE PRESSURE. VII: ETHANE
W. T. Ziegler, B. S. Kirk, J. C. Mullins, and A. R. Berquist 31 Dec. 1964 65 p refs
(Contract CST-1154)
(TR-2) Available from Natl. Bur. of Standards: $2.50

Thermodynamic relations were used to compute the vapor pressure and heats of vaporization and sublimation of ethane at one-degree intervals from 184.52° K (the normal boiling point) to 20° K. These calculations made use of the best available experimental data for the normal boiling point and triple point temperatures, the heat of vaporization at the normal boiling point and heat of fusion at the triple point, heat capacity and density of the saturated condensed phases, and a representation of the second virial coefficient as a function of temperature based on the Kihara core model. The necessary thermodynamic properties of the ideal gas phase were computed from statistical mechanical relations using an internal rotation barrier of 2875 cal/gm mole. Author

N65-20478*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EQUILIBRIUM THERMODYNAMIC PROPERTIES OF CARBON DIOXIDE

Harry E. Bailey Washington, NASA, 1965 69 p refs
(NASA-SP-3014) CFSTI: HC $3.00/MF $0.75

Entropy, enthalpy, pressure, and speed of sound of carbon dioxide computed for wide ranges of temperature and density are presented graphically. The temperature range is 250° K $\leq T \leq$ 25 000° K (ΔT = 250° K). The density range is $-7.0 \leq \log \rho/\rho_o \leq +3.0$ ($\Delta \log \rho/\rho_o = 0.2$) Author

N65-20479*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
CHARTS FOR EQUILIBRIUM FLOW PROPERTIES OF CARBON DIOXIDE IN HYPERVELOCITY NOZZLES
Leland H. Jorgensen and Robert J. Redmond Washington, NASA, 1965 74 p refs
(NASA-SP-3015) CFSTI: HC $3.00/MF $0.75

For initial stagnation pressures from 1 to 1000 atm and stagnation enthalpies from 400 to 20 000 Btu/lb, nozzle-flow properties for equilibrium carbon dioxide have been computed and plotted on charts. Properties charted as a function of Mach number are as follows: temperature, pressure, density, speed, area ratio, dynamic pressure, stagnation-point pressure coefficient, Reynolds number, isentropic exponent, and molecular weight ratio. Temperatures, pressures, and densities across normal shock waves are also charted, and weight-flow rate is plotted as a function of stagnation enthalpy. Author

N65-20488*# General Electric Co., Cincinnati, Ohio. Missile and Space Div.
ALKALI METALS BOILING AND CONDENSING INVESTIGATIONS Quarterly Progress Report No. 10, Oct. 1–Dec. 31, 1964
F. E. Tippets and G. L. Converse, ed. 20 Jan. 1965 381 p refs
(Contract NAS3-2528)
(NASA-CR-54308) CFSTI: HC $7.00/MF $2.00

Work to obtain two-phase heat transfer and fluid flow data for potassium under conditions approximating those anticipated in large space turboelectric power systems was performed. It included the *300-kW Project*—loop and test section, data reduction, data evaluation, and test planning; *100-kW Project*—loop and test section, data reduction, and evaluation; *50-kW Project*—loop and test section, data reduction and evaluation, and test planning; *Facilities*—300-, 100-, and 50-kW loop; *Instrumentation and Materials Support* for 300-, 100-, and 50-kW loop; and *Analysis*—vapor generation by nucleate boiling, evaporation, or a combination of both. Reduced 300-kW data, the calculation procedures used, and data for 100-kW as well as for 50-kW boiling are also given. G.G.

N65-20550# Naval Weapons Evaluation Facility, Albuquerque, N. Mex.
ANALYSIS OF HEAT TRANSFER IN A TWO-LAYER SLAB: CONSTANT FLUX ON ONE SURFACE AND ZERO FLUX ON OTHER SURFACE
Albert C. Giere and M. Elena Franklin 31 Dec. 1964 51 p refs
(NAVWEPS-8005; AD-454926)

The one-dimensional differential equation of heat conduction is solved for an infinite two-layer slab. The layers are in perfect thermal contact. The outer surface of the first layer receives a constant heat flux from its environment; the outer surface of the second layer does not have any heat flux leaving it. A formal application of the Laplace transform gives an analytic solution for the temperature distribution in the classic form of an infinite series. Roots of a transcendental equation needed for the series are included. Author

N65-20569# Dynamic Science Corp., South Pasadena, Calif.
STUDY OF FORCES ON PROPELLANTS DUE TO HEAT TRANSFER INFLUENCING PROPELLANT TEMPERATURE IN A RECOVERY TYPE VEHICLE Final Report
15 Jan. 1965 128 p refs Prepared for Lockheed Missiles and Space Co., Sunnyvale, Calif.
(R-6)

The heat-transfer problem in a partially filled propellant tank system of an Agena space vehicle was formulated in a lumped capacity form which can be solved in principle by using an analog computer. The heat-transfer mechanisms considered contain internal radiation, phase change due to evaporation and condensation, conduction, free convection and convection in liquid layers due to differential surface tension. Transport properties for gaseous UDMH, IRFNA and mixtures of helium with each gas were obtained by computation and experiment. Mass diffusivities for two and three component mixtures were computed by the methods of Bird, Stewart and Lightfoot. Viscosities and heat capacities for gaseous UDMH and nitric acid were rigorously computed; thermal conductivities of single gases were then calculated from the Eucken equation. Thermal conductivities of gas mixtures were calculated from the Mason-Saxena equations. Author

N65-20604# General Electric Co., Philadelphia, Pa. Space Sciences Lab.
STUDY OF RADIATION HEAT FLUX FROM HIGH PRESSURE AIR ARCS Technical Report, Dec. 1963–Nov. 1964
C. H. Marston Arnold AF Sta., Tenn., Arnold Eng. Develop. Center, Jan. 1965 161 p refs
(Contract AF 40(600)-1080)
(AEDC-TR-65-11; AD-454992)

A computational model was applied for calculating radiant heat flux from an electric arc using real gas properties and taking into account both self-absorption and space varying temperature. The model requires knowledge of the temperature profile as an input. Temperature profiles were measured spectrographically using an air arc at 1 and 2.4 atmospheres. These measured profiles plus some simple analytic ones which satisfied boundary conditions were used to calculate radiant heat flux at pressures from 1 to 300 atmospheres. The experimental program also included measurements of radiant flux density at 2.2 and 5.7 atmospheres for comparison with calculations based on the measured profiles. Author

N65-20608# David Taylor Model Basin, Washington, D. C. Aerodynamics Lab.
ABLATION EXPERIMENTS WITH PLASTICS AT HYPERSONIC SPEEDS AND AT LOW HEAT-TRANSFER RATES
Vernon Van Hise and Michael J. Malia Nov. 1964 69 p refs
(DTMB-1903; DTMB-1082; AD-612269)

The ablation behavior of the plastics polyethylene, Teflon, and polycarbonate was studied for various model configurations. Tests were conducted at Mach 7.0 and 9.3 and at low convective heating rates with stagnation temperatures about 1350° F and stagnation pressures about 300 psia. A few initial tests concerned a flat-plate shape and a flat-faced disk shape. These tests included melt flow observations and some crude comparison studies of the various materials. The remaining tests concerned two dozen plastic cone-shaped models which were exposed to wind tunnel conditions for various durations up to 60 seconds. Shape change studies were made of these conical models using, as control devices, ablation rods ejected from the apex and flow-separation ablation spikes. It was seen that, with proper matching of materials, shape changes in the conical models could be virtually eliminated by means

of apex ejection. The ablation spikes were found to maintain a conical apex region by shifting the heat load downstream where it could be absorbed with relatively little shape change. Author

N65-20618# Martin Co., Baltimore, Md.
ONE-DIMENSIONAL SHOCK PROPAGATION WITH THERMAL RADIATION
K. C. Wang Mar. 1965 75 p refs
(RR-47)

The classical problem of the motion of a one-dimensional unsteady shock generated by a piston moving with velocity $v_p = Ct^n$ is extended to take into account thermal radiation effects by the similarity method of Taylor and Sedov. Gray gas and local thermodynamic equilibrium are assumed, and modified Schuster–Schwarzschild differential equations for the heat flux are adopted. The optical thickness is not restricted, and the absorption coefficient is assumed to vary with the density and temperature. Two similarity conditions are introduced. Calculated results for different values of the piston speed, ambient density, specific heat ratio, and absorption coefficient were obtained. In general, the pressure and velocity are not affected much by the radiation, but the density, temperature, and radiant heat fluxes change considerably. Thin solutions for both cylindrical and spherical cases are also carried out. It seems likely that similarity solutions to the Cauchy problem, detonation, explosion, and other similar types of problems may be extended to take thermal radiation into consideration. Author

N65-20636# Royal Aircraft Establishment, Farnborough (England).
A NEW METHOD OF PRESENTING COOLING DATA FOR AIRCRAFT ELECTRICAL MACHINES
C. S. Hudson and M. H. Walshaw London, Min. of Aviation, May 1964 29 p refs
(RAE-IEE-1)

In blast-cooled electrical machines in aircraft the permissible mass flow of cooling air, the electrical output, the air outlet pressure (a function of aircraft altitude), the air inlet temperature (a function of aircraft speed and altitude), and the pressure drop across the machine are all related to each other. Experimental data concerning these quantities are obtained from rating tests on a prototype machine, and are generally presented graphically by means of a rating data chart. A new form of rating data chart is described, consisting of four component graphs. It was derived from the heat-transfer and pressure-drop correlation equations of the physical system, and it expresses mass flow as a function of electrical output, pressure and temperature, and pressure drop as a function of mass flow, pressure, and temperature. This form of presentation enables it to cover accurately the wide ranges of pressure and temperature which obtain in modern high-performance aircraft. The accuracy of the new form of chart was assessed from charts for five machines, and is considerably greater than that of the simpler form of chart generally used at the present time. Author

N65-20639# National Gas Turbine Establishment, Pyestock (England).
THE PERFORMANCE OF A COMBUSTION ZONE FED BY A LARGE NUMBER OF SMALL JETS
R. A. Jeffs and S. W. White London, Min. of Aviation, Dec. 1967 37 p refs
(NGTE-R-209)

An attempt is made to create a homogeneous mixture of fresh and burning gases relying on the mixing processes of a large number of small jets of premixed combustibles. The performance of such a system is superior to that of two types of can employing a large-scale flow reversal except in the presence of liquid fuel droplets at low air temperatures. The efficiency measured with a mixture inlet temperature of 200° C approaches that predicted by semiempirical homogeneous reaction rate theory, and the heat-release rate reaches about 40% of that of a homogeneous reactor at stoichiometric mixture strength. As the reaction rate decreases with mixture strength below the stoichiometric values, so the experimental heat release rate becomes a higher fraction of the theoretical. At an equivalence ratio of 0.6, this fraction becomes about 78%. Author

N65-20668# Royal Aircraft Establishment, Farnborough (England).
AN EXPERIMENTAL ASSESSMENT OF THE HEAT TRANSFER PROPERTIES OF PROPANE IN A NEAR ZERO GRAVITY ENVIRONMENT
J. Rex and B. A. Knight London, Min. of Aviation, Aug. 1964 53 p refs
(RAE-TN-SPACE-69)

An experiment to determine the heat-transfer properties of propane in a near-zero environment was carried in a Skylark rocket head. The experiment was conducted while the rocket head was in a ballistic trajectory, i.e., after separation from the booster. The rotation of the head was reduced to a minimum by an air jet control set. Gravity levels on the experiment of less than 4.5×10^{-5} g were achieved for 3 min 40 sec. The results of the experiment show that the heat transfer to the propane, in the near-zero gravity environment provided, was by nucleate boiling, at a rate of approximately one-third of the rate under 1-g conditions. Author

N65-20675# Rocket Propulsion Establishment, Westcott (England).
FLAMES SUPPORTED BY PERCHLORIC ACID. PART II: THE DECOMPOSITION FLAME
G. A. Mc D. Cummings and G. S. Pearson London, Min. of Aviation, Oct. 1963 11 p refs
(RPE-TN-226)

A decomposition flame of perchloric acid was stabilized using the vapor from aqueous perchloric acid (72% by weight). The burning velocity and temperature agree well with computed values when allowance is made for the nonequilibrium distribution of chlorine in the product gases. It is concluded that the overall activation energy for the decomposition flame is close to 45 kcal $mole^{-1}$. Author

N65-20680# Oak Ridge National Lab., Tenn. Instrumentation and Controls Div.
SMOOTHED THERMOCOUPLE TABLES OF EXTENDED SIGNIFICANCE (°C). VOLUME 2, SECTION 2.1: PLATINUM VS PLATINUM-10% RHODIUM THERMOCOUPLES
R. K. Adams and E. G. Davisson Mar. 1965 55 p refs
(Contract W-7405-ENG-26)
(ORNL-3649, Vol. 2, Sect. 2.1) CFSTI: $3.00

Tabulations are given of smoothed emf (in absolute millivolts) vs temperature and of emf differences for platinum vs platinum–10% rhodium thermocouples. A figure shows the microvolt difference between smoothed and reference values of emf. E.P.V.

N65-20681# Oak Ridge National Lab., Tenn. Instrumentation and Controls Div.
SMOOTHED THERMOCOUPLE TABLES OF EXTENDED SIGNIFICANCE (°C). VOLUME 2, SECTION 2.2: PLATINUM VS PLATINUM-13% RHODIUM THERMOCOUPLES
R. K. Adams and E. G. Davisson Mar. 1965 52 p refs
(Contract W-7405-ENG-26)
(ORNL-3649, Vol. 2, Sect. 2.2) CFSTI: $3.00

Tabulations are given of smoothed emf (in absolute millivolts) vs temperature and of emf differences for platinum vs platinum–13% rhodium thermocouples. A figure shows the microvolt difference between smoothed and reference values of emf. E.P.V.

N65-20682# Oak Ridge National Lab., Tenn. Instrumentation and Control Div.
SMOOTHED THERMOCOUPLE TABLES OF EXTENDED SIGNIFICANCE (°C). VOLUME 2, SECTION 2.3: CHROMEL-ALUMEL THERMOCOUPLES
R. K. Adams and E. G. Davisson Mar. 1965 48 p refs
(Contract W-7405-ENG-26)
(ORNL-3649, Vol. 2, Sect. 2.3) CFSTI: $3.00

Tabulations are given of smoothed emf (in absolute millivolts) vs temperature and of emf differences for chromel–alumel thermocouples. A figure shows the microvolt difference between smoothed and reference values of emf. E.P.V.

N65-20683# Oak Ridge National Lab., Tenn. Instrumentation and Controls Div.
SMOOTHED THERMOCOUPLE TABLES OF EXTENDED SIGNIFICANCE (°C). VOLUME 2, SECTION 2.4: IRON-CONSTANTAN THERMOCOUPLES
R. K. Adams and E. G. Davisson Mar. 1965 32 p refs
(Contract W-7405-ENG-26)
(ORNL-3649, Vol. 2, Sect. 2.4) CFSTI: $2.00

Tabulations are given of smoothed emf (in absolute millivolts) vs temperature and of emf differences for iron–constantan thermocouples. A figure shows the microvolt difference between smoothed and reference values of emf. E.P.V.

N65-20684# Oak Ridge National Lab., Tenn. Instrumentation and Controls Div.
SMOOTHED THERMOCOUPLE TABLES OF EXTENDED SIGNIFICANCE (°C). VOLUME 2, SECTION 2.5: COPPER-CONSTANTAN THERMOCOUPLES
R. K. Adams and E. G. Davisson Mar. 1965 22 p refs
(Contract W-7405-ENG-26)
(ORNL-3649, Vol. 2, Sect. 2.5) CFSTI: $2.00

Tabulations are given of smoothed emf (in absolute millivolts) vs temperature and of emf differences for copper–constantan thermocouples. A figure shows the microvolt difference between smoothed and reference values of emf. E.P.V.

N65-20720# Los Alamos Scientific Lab., N. Mex.
THEORY OF HEAT PIPES
T. P. Cotter 26 Mar. 1965 36 p refs
(Contract W-7405-ENG-36)
(LA-3246-MS) CFSTI: $2.00

A heat pipe is a self-contained structure which achieves very high thermal conductance by means of two-phase fluid flow with capillary circulation. A quantitative engineering theory for the design and performance analysis of heat pipes is given. Author

N65-20735# Royal Aircraft Establishment, Farnborough (England).
SPECTRAL ABSORPTANCE OF METAL SURFACES WITHIN THE SOLAR SPECTRAL BANDWIDTH
J. Porter and E. A. W. Butler London, Min. of Aviation, Apr. 1964 25 p refs
(RAE-TN-SPACE-64)

Measurements were made of the spectral hemispherical reflectance of a variety of representative metal surfaces over the bandwidth occupied by the sun's radiant energy spectrum, and an effective solar absorptance computed for each surface. The application of the surface treatments for use as thermal control surfaces in satellites is discussed, and necessary additional work in the evaluation of thermal control surfaces suggested. Author

N65-20737# Royal Aircraft Establishment, Farnborough (England).
A METHOD FOR CORRECTING MEASUREMENTS OF THE HEAT TRANSFER FACTOR THROUGH THE SKIN OF A WIND TUNNEL MODEL
B. A. M. Piggott London, Min. of Aviation, May 1964 18 p refs
(RAE-TN-MATH-110)

In an experiment to measure the heat transfer factor at the outer surface of the skin of a wind-tunnel model, the temperature of the skin is measured at various points on this surface, and the heat flow rate across the skin is measured at the corresponding points on the inner surface. Calculation of the heat flow rate across the outer surface of the skin involves the solution of Laplace's equation in a rectangular region with mixed boundary conditions. A numerical method of solution is described and illustrated by an example. Author

N65-20739# Royal Aircraft Establishment, Farnborough (England).
LOAD CAPACITY AND HEAT TRANSMISSION FOR NYLON CORDAGE THRUST INTO A HOT ENVIRONMENT
J. E. Swallow and M. W. Webb London, Min. of Aviation, Feb. 1963 18 p refs
(RAE-TN-CPM-7)

A method is described for measuring the rate of temperature rise at the surface and axis of circularly woven nylon cordage at several load levels when suddenly thrust into a hot airstream at temperatures up to 340° C. The fractional temperature rise was dependent on time and to a lesser extent on load, but was independent of ambient temperature. The thermal diffusivity under zero load was 4.8×10^{-4} cm^2/sec. The times for which the cordage could support loads at airstream temperatures up to 440° C were determined. Author

N65-20748# Rocket Propulsion Establishment, Westcott (England).
FLAMES SUPPORTED BY PERCHLORIC ACID: PART 1 PREMIXED FLAMES WITH METHANE
G. A. Mc D. Cummings and A. R. Hall London, Min. of Aviation, Jun. 1963 22 p refs
(RPE-TN-222)

Premixed flames of methane–perchloric acid (72% by weight in water) were stabilized on burners at both normal and reduced pressures. Their spectra were recorded, and their burning velocities measured. Comparison of the results obtained with the corresponding properties of the methane–oxygen flame shows that perchloric acid or its decomposition products are more reactive oxidizers than molecular oxygen and some indication of the possible course of the reaction is given. Author

N65-20749# Royal Aircraft Establishment, Farnborough (England).
THE PRESENTATION OF COOLING DATA FOR AIRCRAFT ELECTRICAL MACHINES
C. S. Hudson London, Min. of Aviation, Jun. 1962 25 p refs
(RAE-TN-EL-207)

The heat transfer and airflow relationships for dynamo electric machines are examined, and a method is described for presenting the information in the form of a 4-stage rating chart. The equations derived and the assumptions made were tested by the analysis of test data for a 40-kVA alternator. Author

N65-20763# Naval Ordnance Lab., White Oak, Md. Air-Ground Explosions Div.
THE FLOW FIELD BEHIND A SPHERICAL DETONATION IN TNT USING THE LANDAU-STANYUKOVICH EQUATION OF STATE FOR DETONATION PRODUCTS Final Report
M. Lutzky Feb. 1965 29 p refs
(NOLTR-64-40; AD-610335)

Calculations were made of the flow field in the isentropic region behind a detonation wave in TNT, using the Landau–Stanyukovich equation of state for the detonation products (as described by Zeldovich and Kompaneets). Adjustable constants in this equation have been evaluated by imposing ideal gas behavior on the detonation products in the large expansion (low density) limit, and by fitting to an experimental curve of detonation velocity versus loading density. Calculated values of Chapman–Jouguet variables correspond fairly well with experimental values at various loading densities, with the exception of the temperatures, which seem to be far too low. This is connected with the fact that the theory predicts an upper limit to the loading density at which an explosive will detonate; at this point the thermal energy vanishes and only the elastic energy contributes to the energy of detonation. Author

N65-20777*# Consultants and Designers, Inc., Arlington, Va.
UNSTEADY FUSION OF BODIES UNDER THE EFFECT OF AERODYNAMIC HEATING [NESTATSIONARNOYE OPLAVLENIYE TEL POD DEYSTVIYEM AERODINAMICHESKOGO NAGREVA]
C. K. Matveyev 4 Nov. 1964 7 p refs Transl. into ENGLISH From Vestn. Leningr. Univ., Ser. Mat., Mekh. i Astron. (Leningrad), no. 13, 1964 p 159–162
(Contract NAS5-3760)
(ST-AD-AMP-10235; NASA-TT-F-8986)

The forming liquid film on a melting surface, subjected to aerodynamic heating, moves under the effect of a pressure gradient and surface friction. The equations of motion of the liquid film are equivalent to the boundary layer equations. The flow at moments of time near the beginning of fusion is considered. The film movement is estimated as laminar and the inertial terms are neglected in the equation expressing the law of the quantity of motion. Also, the heat from the frictional forces is neglected. The deceleration temperature was estimated to be approximately equal to the thermodynamic temperature. The transition to Lagrange variables is used to simplify the solution of the problem. E.E.B.

N65-20812*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
RADIANT HEAT TRANSFER TO ABSORBING GASES WITH FLOW AND CONDUCTION
T. H. Einstein [1962] 8 p refs Presented at the ARS/ANS/IAS Nucl. Propulsion Conf., Monterey, Calif., 15–17 Aug. 1962
(NASA-TM-X-56222) CFSTI: HC $1.00/MF $0.50

A two-dimensional analysis of radiation heat transfer is made for a gray gas enclosed in a rectangular channel formed by two black parallel flat plates of finite length and infinite width. A modified Hottel's zoning technique is used. The heat balance is taken on an infinitesimal volume of the center of the zone resulting in reduction of the effort required to compute the exchange factors. The obtained results are presented in generalized form for the case of radiation to flowing gases and also for combined radiation and conduction. G.G.

N65-20862# Boeing Co., Seattle, Wash.
THERMAL CONDUCTIVITY OF Q-FELT INSULATION AT ELEVATED TEMPERATURES Final Report, Apr. 1–Aug. 15, 1964
T. W. Eichenberger [1964] 103 p refs
(Contract AF 33(615)-1624)
(D2-81285; AD-455328)

The thermal conductivity of Q-felt, a commercial microquartz fibrous insulation material, was evaluated. Tests were conducted on several densities each of as-received and thermally stabilized material at elevated temperatures and at atmospheric and reduced pressures. Mean test temperatures ranged from 200° to 2560° F, and reduced pressures to 0.1 mm/mercury were used. Curves were prepared presenting the mean apparent thermal conductivity of both thermally stabilized and unstabilized Q-felt as a function of mean temperature, gas pressure, and material density. Author

N65-20871# Aerojet-General Corp., Sacramento, Calif.
INVESTIGATIONS OF THE MECHANISMS OF DECOMPOSITION, COMBUSTION, AND DETONATION OF SOLIDS Annual Report, Mar. 1964–Feb. 1965
F. J. Cheselske 15 Mar. 1965 240 p refs
(Contract AF 49(638)-851; ARPA Order 24-60)
(Rept.-0372-01F; AD-458854)

The results of research on the mechanisms of decomposition, detonation, and combustion of solids are summarized. Extensive kinetic studies were made on linear surface regression rates of solid high explosives (TNT, RDX, etc.), sublimation of ammonium halides, thermal decomposition of anhydrous perchloric acid, and apparent flame strength measurements on NH_3 with O_2, Cl_2, NO, and N_2O in the opposed-jet diffusion flame reactor. Preliminary phenomenological studies were carried out on the decomposition of pure or nearly pure single crystals of ammonium perchlorate. Theoretical studies were made on reactions in opposed-jet diffusion flames. New models were developed to explain extinction phenomena in solid rocket motors and a low pressure deflagration limit (P_{DL}). Author

N65-20919# Naval Air Development Center, Johnsville, Pa. Aviation Medical Acceleration Lab.
STUDIES IN THERMAL PROTECTION. I: EXPERIMENTAL APPROACH AND PROCEDURES Progress Report
Alice M. Stoll and Maria A. Chianta 4 Feb. 1965 17 p refs
(NADC-ML-6417; AD-459092)

Apparatus and methods for the analysis of heat flow and thermal properties of fabrics and thin flexible materials are described. Their application in studies of protection from burns due to radiation is discussed and compared with those appropriate to studies of flame contact. From the point of

view of screening candidate materials for any given application, it is sufficient to examine only the empirical data obtained by subjecting a specimen to the thermal pulse concerned. However, to provide guide lines for the creation of fabric structures and polymers intended for protection of the underlying skin from specific thermal hazards, analyses of the type discussed here are essential. The techniques and resultant information described, together with standard procedures, can provide all the data required for this latter purpose. They are so utilized currently, both for the study of fabrics and for the development of specialized thermal protection materials.

Author

N65-20920# Michigan Univ., Ann Arbor. Liquid Metals Lab.
INVESTIGATION OF LIQUID METAL BOILING HEAT TRANSFER
Richard E. Balzhiser, Robert E. Barry, Bruce F. Caswell, Herman Merte, Jr., Andrew Padilla, Jr. et al Feb. 1965 140 p refs
(Contract AF 33(657)-11548)
(Rept.-05750-19-P; AD-458266)

Critical heat flux determinations were completed for sodium and rubidium. Values fall above the predictions based on hydrodynamic considerations. A modified design for the film boiling apparatus avoids the difficulties encountered with the use of condensing liquid metals as a heat source. Forced circulation studies were terminated after obtaining additional two phase flow data to repair the ruptured bellows in the test section. The difficulties in obtaining continuous flow since that time are discussed and conclusions reached regarding the use of zirconium as a hot trapping medium are cited. Recent cold filtering procedures, excluding the hot trap, have provided encouraging results. Agravic results for mercury were obtained in the nucleate and film boiling regimes. Accelerations up to 15 times that of normal gravity were studied with definite effects on the heat transfer coefficient observed. Author

N65-20983*# United Aircraft Corp., East Hartford, Conn.
EXPERIMENTAL INVESTIGATION OF THE OPACITY OF SMALL PARTICLES
P. J. Marteney Washington, NASA, Apr. 1965 52 p refs
(Contract NASw-847)
(NASA-CR-211) CFSTI: HC $3.00/MF $0.50

An experimental investigation was conducted to develop a technique for producing dispersions of submicron-radius solid particles in a carrier gas and to determine the optical parameters of these particles as a function of the wavelength of electromagnetic radiation incident upon the particles. A dispersion system was devised which permitted (1) mixing of measured amounts of agglomerated submicron particles with metered quantities of preselected carrier gases, (2) application of deagglomerative aerodynamic shear forces in a restrictive flow passage (nozzle) through which the carrier gas-particle mixture was passed, and (3) measurement of the extinction and scattering characteristics of the deagglomerated particles downstream of the nozzle. Tests were conducted with carbon and tungsten particles having nominal radii of 0.0045 and 0.01 microns, respectively. Helium and nitrogen were used as carrier gases. The application of aerodynamic shear forces in the tests resulted in an increase in the extinction parameter for carbon particles from approximately 10 000 cm^2/gm to 58 000 cm^2/gm and for tungsten particles from approximately 2000 cm^2/gm to 8000 cm^2/gm. Author

N65-20984*# United Aircraft Corp., East Hartford, Conn.
THERMODYNAMIC PROPERTIES OF COOLANT FLUIDS AND PARTICLE SEEDS FOR GASEOUS NUCLEAR ROCKETS
R. Roback Washington, NASA, Apr. 1965 25 p refs
(Contract NASw-847)
(NASA-CR-212) CFSTI: HC $1.00/MF $0.50

Thermodynamic properties and equilibrium chemical composition were calculated for various materials which could serve as moderator coolants or as particle seeds designed to control radiant heat transfer in gaseous nuclear rocket engines. The materials considered as moderator coolants were hydrogen, methane, water, ammonia, deuterium, heavy water, and helium. Materials considered as possible particle seeds were several elemental species which have high boiling points, such as graphite, tungsten, and molybdenum, and the oxides, carbides, nitrides, and borides of titanium and zirconium. The results of the calculations indicate that the use of graphite as a seed material is impractical because graphite reacts readily with hydrogen, and, consequently, excessive quantities of graphite must be added to the hydrogen stream to maintain even very small concentrations of seed particles at high temperatures. Also, the limited thermodynamic data currently available indicate that no significant increase in particle vaporization temperature would result from using oxides, carbides, nitrides, or borides of such high-melting-point metals as titanium and zirconium as seeds in place of the metals themselves. Author

N65-20991*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TRANSIENT SURFACE TEMPERATURE DISTRIBUTION OF A THIN-WALLED SPHERE SUBJECTED TO RADIATION IN SPACE
Glenn E. Schober Washington, NASA, Apr. 1965 30 p refs
(NASA-TN-D-2728) CFSTI: HC $2.00/MF $0.50

This report derives and investigates the partial differential equation governing the transient temperature distribution of a thin-walled sphere in the conditions of outer space. The sphere is initially at a uniform temperature and then subjected to radiant energy transfer. A source, such as the sun, radiates energy to the sphere, and the sphere radiates energy to a sink, such as outer space, at some background temperature. Energy is transferred within the sphere wall by conduction. Formulas are derived for cases when the differential equation can be approximated, and approximations of the complete solution are given. From the solutions for a special case it is possible to deduce the rapid growth of the temperature distribution on the sphere and the symmetry connected with it. In addition, formulas are derived for the variation of the average temperature level of the sphere with time both in the case of a constant specific heat and in the case of a temperature dependent specific heat. These formulas also apply to a body cooling down in the absence of a radiating source. Author

N65-21018# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
SEPARATED FLOW STUDIES AT HYPERSONIC SPEEDS. PART I: SEPARATED FLOWS OVER AXISYMMETRIC SPIKED BODIES
Michael Holden Dec. 1064 43 p refs
(Contract Nonr-2653(00))
(CAL-AF-1285-A-13(1); AD-612758)

The results of a study of laminar airflow over spiked bodies at Mach 10 and Mach 15 in a gun tunnel are presented. The heat transfer rates developed in the reattachment region of a conical shear layer and the parameters which influence the total aerodynamic heating of a spiked body are emphasized. The magnitude of the reattachment heat transfer rate in a face reattachment region of a cone was found to be directly proportional to the reattachment angle of the shear layer. The maximum local heat transfer rates in these regions were found to exceed the corresponding value without the presence

of a spike by factors up to 4. The total heat transfer to the spiked bodies was found to vary markedly with body shape, spike length, and Mach number. The most important factor which influenced total heat transfer was the position of the reattachment point. E.E.B.

N65-21061# Library of Congress, Washington, D.C. Aerospace Technology Div.
COMBUSTION INSTABILITY: ANALYTICAL SURVEY, JANUARY 1958–APRIL 1964
10 Mar. 1965 66 p refs
(ATD-P-65-9; AD-459097) CFSTI: HC $3.00/MF $0.75

Soviet developments in combustion instability in liquid rockets and ramjet engines are summarized. The majority of the Soviet studies included deal with the interaction of shock and pressure waves with the flame front. These studies are of high phenomenological interest. Only two articles on low-frequency instability were found in Soviet open literature. Further, experimental studies or analyses of high-frequency instability which take into account actual engine operation, i.e., mixing, evaporation, and dissociation fuel atomization, were not found in the literature surveyed. However, several theoretical studies were found on this subject dealing with idealized conditions. E.E.B.

N65-21077# European Atomic Energy Community, Brussels (Belgium).
HIGH-TEMPERATURE VAPOR PRESSURE STUDIES OF UO_2 BY THE EFFUSION METHOD
R.W. Ohse Nov. 1964 53 p refs
(EUR-2166.e) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 85 Belg. Fr.

A high-temperature effusion investigation of the vapor pressure of uranium dioxide under high vacuum is presented over the temperature range 2200° to 2800° K. The theory, experiment, and applicability of the Knudsen effusion method and the Langmuir rate of evaporation method are described in detail. The construction of effusion cells with particular attention to questions of compatibility, cosine distribution, molecular flow and Clausing factor, temperature distribution, and temperature measurement is discussed. The blackbody hole readings are corrected for both the transmissivity of interposed windows and the cavity temperature of the effusion cell. The spectral emissivity of tungsten is measured as a function of temperature by the application of Wein's radiations law in the whole range under consideration. The spectral emissivity at 0.65 microns decreases from 0.44 at 2300° K to 0.416 at 2350° K. The mathematical treatment on behalf of gas kinetic considerations and the thermodynamic treatment according to the second and third law method of the effusion measurements are outlined. The X-ray diffraction studies, micrographic and radiometric methods are applied to investigate the compatibility of W with UO_2, the congruent vaporization of UO_2 and the condensation coefficient and invariance of the measurements. Author

N65-21119# McGill Univ., Montreal (Quebec). Mechanical Engineering Research Labs.
TURBULENT FLAME STRUCTURE, A SURVEY OF LITERATURE
A.M. Ahmed Mar. 1965 69 p refs
(Grant DRB-G-9550-06)

The different flame models currently in use for turbulent flame studies were critically analyzed. Flame models were described, experimental evidence was reviewed, theoretical work discussed, and results were compared with experimental data. It was concluded from this survey that basic questions are still unanswered and that not one single aspect of turbulent flames is as yet clearly understood. Experimental evidence confirms conflicting models over the same range of parameters. A model for further study is proposed. E.E.B.

N65-21140# Aeronautical Research Inst. of Sweden, Stockholm.
DETERMINATION OF THE SIZE OF ICE CRYSTALS FORMED DURING CONDENSATION OF WATER IN WIND TUNNELS AND OF THEIR EFFECT ON BOUNDARY LAYERS
H. Thomann Jul. 1964 82 p refs
(FFA-101)

The size of the ice crystals formed during the expansion of humid air in a supersonic nozzle is determined. This is done by analyzing samples sucked into pitot probes. Small probes read a higher humidity than is present in the free stream. This increase is a measure of the inertia of the crystals and thus of their size. For spherical crystals, a radius of 14 Å ($1.4 \cdot 10^{-9}$m) is predicted which means that a crystal contains about 300 molecules. This result is confirmed by measuring the evaporation rate of crystals behind normal shocks. It is further found that the particles are of fairly uniform size. No variation of the size with humidity was found for water concentrations below $2 \cdot 10^{-3}$. The effect of condensation on laminar boundary layers is investigated. If it is assumed that either no crystals reevaporate in the boundary layer or that, in each volume inside the boundary layer, the mixture of crystals, vapor, and air is in thermodynamic equilibrium, a theoretical solution can be given. It is found that measurements of recovery temperature, heat transfer, and water concentration are in good agreement with the predictions of the equilibrium theory. A few remarks are also made about turbulent boundary layers and about the effect of air liquefaction in hypersonic tunnels. Author

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N65-20134# Joint Publications Research Service, Washington, D.C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 161
19 Mar. 1965 143 p refs Transl. into ENGLISH of selected articles from Chinese Publ.
(JPRS-29200; TT-65-30547) CFSTI: $4.00

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20. PENG CHIA-MU: AN UNUSUAL SCIENTIST p 136–139

N65-20163*# National Aeronautics and Space Administration, Washington, D. C.
A SELECTED LISTING OF NASA SCIENTIFIC AND TECHNICAL REPORTS FOR 1964
[1965] 1137 p refs
(NASA-SP-7018) GPO: $5.25; CFSTI: MF $5.00

A selected listing of NASA Scientific and Technical Reports for 1964 assembles in one publication a listing of NASA reports and journal articles that were announced during 1964 in *STAR* a semimonthly abstract/index journal. Special publications, technical reports, notes, memorandums, translations, reprints, and contractor reports are included. R.W.H.

N65-20283# Congress. House. Committee on Science and Astronautics.
PANEL ON SCIENCE AND TECHNOLOGY, SIXTH MEETING
Washington, GPO, 1965 106 p Proc. before Comm. on Sci. and Astronautics, 89th Congr., 1st Sess., 26–27 Jan 1965

CONTENTS:

1. OPENING REMARKS AND STATEMENTS p 1–9

2. EUROPEAN PROGRESS IN AERONAUTICS Luigi Broglio (Italian Space Res. Commission) p 10–13

3. SURVEY OF V/STOL TRANSPORTATION TECHNOLOGY Martin Goland (Southwest Res. Inst.) p 13–34

4. STATUS OF THE U.S. SUPERSONIC TRANSPORT PROGRAM N. E. Halaby (FAA) p 34–46

5. STATEMENT OF DR. J. HERBERT HOLLOMAN, ASSISTANT SECRETARY FOR SCIENCE AND TECHNOLOGY, DEPARTMENT OF COMMERCE p 46–68

6. THE FUTURE OF AERONAUTICS IN THE UNITED STATES H. Guyford Stever (MIT) p 68–79

7. STATEMENT OF GEN. BERNARD A. SCHRIEVER, COMMANDER, AIR FORCE SYSTEMS COMMAND, U.S. AIR FORCE p 79–95

APPENDIX A

8. A SURVEY OF V/STOL TRANSPORTATION TECHNOLOGY Martin Goland 95–103

N65-20312# Congress. House. Committee on Science and Astronautics
MASTER PLANNING OF NASA INSTALLATIONS
George P. Miller Washington, GPO, 1965 50 p Rept. of the Comm. on Sci. and Astronautics, 89th Congr., 1st Sess., Union Calendar No. 62, House Rept. No. 167, 15 Mar. 1965

A Congressional committee studied 10 NASA base facilities to gain information on facility planning for space programs. Land, buildings, test stands and launch pads, utilities, roads, and transportation were the objects surveyed. Master planning was first reviewed for several civilian and military government agencies, and was then studied at various existing NASA centers. It was concluded that master planning by individual centers is economically feasible, that there need not be uniformity in plans for different facilities, and that development of new space installations should be based in part on privately invested money. The overall order issued in this committee report is that planning should be directed toward creating permanent facilities, since major effort will continue in space research. J.M.D.

N65-20322*# George Washington Univ., Washington, D. C.
THE GEORGE WASHINGTON UNIVERSITY MAGAZINE, VOLUME ONE, NO. FOUR, WINTER 1965
Margaret Davis, ed. 1965 36 p
(NASA-CR-57619) CFSTI: HC $2.00/MF $0.50

CONTENTS:

1. WHERE NEXT IN SPACE? J. E. Webb p 1–2 (See N65-20323 10-11)

2. A PLANETARIUM AND SPACE CENTER FOR WASHINGTON Benjamin D. Van Evera p 3–5

3. RUSSIAN LIFE IN SPACE J. W. Tyson p 6–9 (See N65-20324 10-04)

4. METROLOGY ESSENTIAL OF THE SPACE AGE A. G. McNish p 10–14

5. INTERNATIONAL COOPERATION IN SPACE Robert S. Jordan p 15

6. SPACE PHOTOGRAPHS p 16–20

7. OUR FIRST COMMENCEMENT Elmer Louis Kayser p 21

8. FREEDOM FROM RELIGIOUS DISCRIMINATION W. T. Mallison, Jr. p 22–25

9. PAUL CARLSON: "A DOCTOR AND A MISSIONARY, NOTHING ELSE" p 26–32

10. WHAT'S IN AN ICELANDIC NAME? John G. Allee, Jr. p 29–32

N65-20390# Library of Congress, Washington, D. C. Aerospace Technology Div.
FOREIGN SCIENCE BULLETIN, VOLUME 1, NUMBER 1, JANUARY, 1965
[1965] 57 p refs Sponsored by ARPA
(AD-609580)

CONTENTS:

1. ELECTRON-BEAM-PUMPED LASER p 1–3 refs (See N65-20391 10-16)
2. STUDIES OF DIFFRACTION OF ULTRASHORT WAVE BY MOUNTAIN PEAKS p 4–7 ref (See N65-20392 10-07)
3. SOVIET RESEARCH ON MICROWAVE POWER GENERATION p 8–18 refs (See N65-20393 10-09)
4. PATTERN RECOGNITION AND THE METHOD OF POTENTIAL FUNCTIONS p 19-22 refs (See N65-20394 10-05)
5. SOVIET RESEARCH ON PHOTOSYNTHESIS p 23–29 refs (See N65-20395 10-04)
6. GROWING PIEZOELECTRIC POTASSIUM NIOBATE p 30–32 refs (See N65-20396 10-08)
7. SCIENCE & TECHNOLOGY NOTES p 33–41 refs
8. CONFERENCES p 42–47 refs
9. SCIENCE PERSONALITIES P. L. Kapitsa p 48–49 refs
10. BOOK REVIEWS p 50–54

N65-20448# National Aeronautics and Space Council, Washington, D. C.

UNITED STATES AERONAUTICS AND SPACE ACTIVITIES, 1964. REPORT TO THE CONGRESS FROM THE PRESIDENT OF THE UNITED STATES

27 Jan. 1965 165 p

The contributions of the various departments and agencies of the Government to the nation's aeronautic and space accomplishments are presented. Included are activities of the National Aeronautics and Space Council, National Aeronautics and Space Administration, Department of Defense, Atomic Energy Commission, Department of State, National Science Foundation, Department of Commerce, Space Science Board, Smithsonian Astrophysical Observatory, Federal Aviation Agency, Federal Communications Commission, and United States Information Agency. Appendixes include charts and tables of U. S. launching records, SNAP power units for space, space launch vehicles, communications satellite ground terminals, historical summaries, and budgets. W.W.

N65-20464# Joint Publications Research Service, Washington, D. C.

CYBERNETICS AND SOCIALIST MANAGEMENT

Georg Klaus and Gerda Schnauss 2 Apr. 1965 20 p refs Transl. into ENGLISH from Einheit (East Berlin), no. 2, Feb. 1965 p 93–104

(JPRS-29409; TT-65-30640) CFSTI: $1.00

The functional behavior of the components of an economic system in the planning and management of a people's economy by cybernetics is discussed. Work with block diagrams permits the combination of more or less complex elements in a cybernetic overall system and simplifies the analyzing conditions. Abstraction by cybernetic methods consists of the following aspects: definition by abstraction as a specific form, discovery of invariants, discovery of transformations, and the black-box suitable for construction. The individual enterprises or economic sectors may be compared to partial systems connected to each other to form a total system with all the characteristics of a multistable cybernetic system. G.G.

N65-20582# Joint Publications Research Service, Washington, D. C.

TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 162

23 Mar. 1965 41 p refs Transl. into ENGLISH of Selected Communist Chinese Articles

(JPRS-29233; TT-65-30562) CFSTI: $2.00

1. NEW TYPES OF POLYMERIZATION REACTIONS H. Yao p 1–17 refs (See N65-20583 10-06)
2. MEASUREMENT OF RESISTANCE OF ELECTRODES OF CRYSTAL TUBE S. Shih p 18–22 refs (See N65-20584 10-09)
3. CRYSTAL TUBE MIXER CIRCUIT (IV) H. Ling p 23–28 refs (See N65-20585 10-09)
4. DISCUSSIONS ON TRANSLATION TERMS OF ELECTRONIC PRODUCTS IN VACUUM TUBE p 29–30 refs (See N65-20586 10-10)
5. METHOD OF READING TYPES OF ELECTRONIC PRODUCTS p 31–32 (See N65-20587 10-34)
6. EXPERIMENTS ON FISH OVULATION INDUCED BY STEROIDS C. Hsing, H. Li, and T. Chang p 33–38 refs (See N65-20588 10-04)

N65-20587 Joint Publications Research Service, Washington, D. C.

METHOD OF READING TYPES OF ELECTRONIC PRODUCTS

In its Transl. on Communist China's Sci. and Technol., No. 162 23 Mar. 1965 p 31–32 Transl. into ENGLISH from Tien-tzu Chi-shu (Shanghai), no. 8, Aug. 1964 p 47 (See N65-20582 10-34) CFSTI: $2.00

The pronunciation of Chinese electronic terms using Chinese phonetic sounds rather than pronouncing them as English words is discussed. It was noted that since most of the electronic products were of non-Chinese origin, these terms were automatically pronounced as English words. The suggestion is made that educational cadres take the lead in the classroom to pronounce electronic terms with Chinese phonetics. E.E.B.

N65-20770# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

COSMOS—ON EARTH AND UNDER THE EARTH

M. Pavlov 14 Jan. 1965 8 p Transl. into ENGLISH from Krasnaya Zvezda (Moscow), Jan. 9, 1964 p 4

(FTD-TT-64-824-1; AD-610330)

Various methods to investigate the effects of radiation of nuclear explosions by simulation in laboratories and underground are briefly outlined. The imitation of nuclear explosions by shock tubes generating pressures of a million pounds per square inch in less than one millionth of a fraction of a second through conventional explosives, compressed air, or by explosion of a metal foil through an electric pulse generator from a capacitor charged to 125 thousand volts is discussed. G.G.

N65-20778# Joint Publications Research Service, Washington, D. C.

TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 163

24 Mar. 1965 125 p refs Transl. into ENGLISH from Chinese periodicals

(JPRS-29270; TT-65-30581) CFSTI: $4.00

CONTENTS:

1. CELEBRATING THE FIFTEENTH ANNIVERSARY OF THE FOUNDING OF THE NATION p 1–8
2. FIVE YEARS' PROGRESS IN PHARMACOLOGICAL CHEMISTRY IN CHINA Chou Chin and Ch'i-ch'eng Fang p 9–34 refs

3. ACHIEVEMENTS IN THE STUDY OF PHARMACOLOGICAL THEORY IN CHINA DURING 1960–1964 Yu-yu Chin and Chen-kang Wang p 35–59 refs

4. FIVE YEARS' PROGRESS IN PHARMACEUTICS IN CHINA Hung-ch'en Wang p 60–68 refs

5. FIVE YEARS' PROGRESS IN DRUG ANALYSIS TECHNIQUES IN CHINA Tseng-p'ei Sun and Yu-lin Shao p 69–81 refs

6. ACADEMY OF AGRICULTURAL SCIENCES FORMED IN SINKIANG p 82–83

7. MEDICAL PERSONNEL IN CANTON AND HANGCHOW FORM MOBILE TEAMS FOR RURAL SERVICE p 84–86

8. THE INTERFERENCE EFFECT OF NUCLEUS UNDER SHORT RANGE FORCES T. Chang, Y. Yu, H. Chu, C. Li, and Yu Min p 87–103 refs (See N65-20779 10-24)

9. STIMULATED EMISSION FROM GaAs P-N JUNCTIONS W. Liu p 104–110 refs (See N65-20780 10-26)

10. BEAT FREQUENCIES OF WAVE MODES OF A LONG OPTICAL RESONANT CAVITY H. Kuo, C. Hang, T. Yang, and H. Yen p 111–115 refs (See N65-20781 10-23)

11. SEPARATION OF WAVE MODES OF GASEOUS LASER H. Kuo, S. Yu, C. Hang, and H. Yen p 116–121 refs (See N65-20782 10-16)

N65-20868# California Univ., Los Angeles. Western Management Science Inst.

THE STRUCTURE OF PRODUCTION AND PROCESSING SYSTEMS

Richard V. Evans [1965] 65 p refs *Its* Western Management Sci. Inst. Working Paper No. 56, Management Sci. Res. Proj. Res. Rept. No. 90

(Contract Nonr-233(73))

(AD-609973)

The interrelationships among the variables common to all systems must be analyzed by four identifiably different methods: functional analysis, numerical analysis, simulation, and real system experimentation. It appears that some of the awkward statistical problems associated with understanding a simulated system may disappear when a search routine controls the system structure, continually modifying it in the search for an optimum. M.P.G.

N65-20891# Radio Corp. of America, Camden, N. J. RCA Service Company Div.

QUEUING TABLES FOR DETERMINING SYSTEM MANNING AND RELATED SUPPORT REQUIREMENTS Technical Report, Feb.–Oct. 1964

R. E. Purvis, R. L. Mc Laughlin, and W. K. Mallory Wright-Patterson AFB, Ohio, AMRL, Dec. 1964 817 p refs

(Contract AF 33(657)-11607)

(AMRL-TR-64-125; AD-458206)

Queuing tables were developed to be directly applicable to characteristics of military systems having quantitative spares, personnel, component failure rates, and operational readiness performance requirements. The tables provide a ready means of estimating the performance capability of a complex system which depends upon capabilities of distinct support units. The tables also provide a manual means of performing trade-off analyses between personnel, logistic support components, test equipments, component reliability and maintainability, and the number of systems to be supported. Examples of the practical applications of the tables are included. Author

N65-20937# Picatinny Arsenal, Dover, N. J. Feltman Research Labs.

DEVELOPMENT OF A STAR SIGNAL FOR THE SPIN-STABILIZED XM147, XM148 AND XM149 CLUSTER SERIES

Joseph Kristal, Burton Werbel, and Seymour Lopatin Mar. 1965 36 p refs

(PA-TR-3172; AD-459463)

Assemblies for providing five-unit red, green, and white light cluster signals were developed for the spin-stabilized hand-held ground signal. In local static and ballistic tests, ejection and ignition of illuminant charges was satisfactory and clusters were distinguishable as five separate light sources. Required burning times were met ballistically, and luminous intensity and color discrimination were found to be adequate. The compositions developed were (1) for red light, atomized magnesium 29%, strontium nitrate 43%, potassium perchlorate 9%, polyvinyl chloride 12%, and Laminac resin 7%; (2) for green light, atomized magnesium 30 parts, barium nitrate 40 parts, dechlorane 12 parts, potassium perchlorate 12 parts, and vinyl–alcohol–acetate resin, 4 parts; and (3) for white light, atomized magnesium 36%, sodium nitrate 40%, potassium perchlorate 10%, dechlorane 4%, and Laminac resin 10%. Author

N65-20965# Universidad Autonoma de San Luis Potosi (Mexico). Escuela de Ingenieria

BASIS FOR THE DEVELOPMENT STUDY OF A ROCKET LAUNCH SITE CREATION AND THE ASSIGNMENT OF SUCH A STUDY AS AN ENGINEERING THESIS [BASES PARA EL DESARROLLO DE UN ESTUDIO SOBRE LA CREACION DE UN SITO DE LANZAMIENTO DE COHETES Y LA ADJUDICACION DE DICHO ESTUDIO A TEMAS DE-TESIS DE INGENIERIA]

Francisco J. Gonzalez 12 Mar. 1965 12 p refs In SPANISH

The importance of investigating the earth's upper atmosphere and the problems that require special study are discussed. Research underway in other countries is reviewed. A space program for Mexico is outlined, its main objectives are discussed, and recommendations for future work are made. Transl. by F.E.R.

N65-21089# Joint Publications Research Service, Washington, D. C.

EAST GERMAN PUBLICATIONS ON CYBERNETICS

12 Mar. 1965 35 p refs Transl. into ENGLISH from East German periodicals

(JPRS-29099; TT-65-30503) CFSTI: $2.00

CONTENTS:

1. CYBERNETIC REGULATION MECHANISMS AND WORLD-WIDE SCIENTIFIC DEVELOPMENTS H. Kelm p 1–23 refs (See N65-21090 10-34)

2. ON THE PERIODICITY OF LATENT PERIODS OF THE "INEXTINGUISHABLE" CONDITIONAL FUGITIVE REFLEX AND THE ATTEMPT OF A CYBERNETIC INTERPRETATION K. Hecht and M. Peschel p 24–32 refs (See N65-21091 10-04)

N65-21090 Joint Publications Research Service, Washington, D. C.

CYBERNETIC REGULATION MECHANISMS AND WORLD-WIDE SCIENTIFIC DEVELOPMENTS

H. Kelm *In its* East German Publ. on Cybernetics 12 Mar. 1965 p 1–23 refs Transl. into ENGLISH from Technik (East Berlin), v. 20, no. 1, Jan. 1965 p 16–22; v. 20, no. 2, Feb. 1965 p 89–91 (See N65-21089 10-34) CFSTI: $2.00

The internal mechanism of controlled automation is discussed as a natural phenomenon. Also, control automation, a central problem of cybernetic control mechanism, is considered. It is noted that the general laws of objective dialectic are more comprehensive than the equally universally acting laws of cybernetics. The laws of dialectic are ultimately also the foundation for the particular effectiveness of cybernetic processes. Cybernetics includes important relations and qualities which contribute to the intensification of knowledge of the dialectic effect, and the understanding of the relations governing the laws of dialectic with respect to each other. The relation between probability and determination, and the problems of cybernetics and social development are also discussed.

E.E.B.

N65-21145# Technisch Documentatie en Informatie Centrum voor de Krijgsmacht, The Hague (Netherlands).

A REVIEW OF LITERATURE ON OPERATIONS RESEARCH

24 Dec. 1964 32 p refs In DUTCH *Its* 8th Yearly Issue, No. OR-65

This review contains several abstracted summaries of research papers pertaining to complex problems in management science and operations research. Mathematical programing techniques are proposed for control system design and optimization, with the application of linear, nonlinear, stochastic, integer, and dynamic programing to various types of control problems. The principal subject areas covered are: (1) mathematical programing techniques for solution of control problems; (2) advances in control theory for mathematical programing in optimal control and related areas; (3) advances in mathematical programing techniques relevant to control applications, and (4) computers and computer programing in control systems.

Trans. by G.G.

N65-21146# Technisch Documentatie en Informatie Centrum voor de Krijgsmacht, The Hague (Netherlands).

A REVIEW OF LITERATURE ON NATURAL SCIENCES AND CHEMISTRY [LITERATUUROVERZICHT, NATUUREN SCHEIKUNDE]

9 Jan. 1965 27 p refs In DUTCH *Its* 16th Yearly Issue, No. A-378

Abstracts and bibliographic notes on chemistry and the natural sciences are listed under various subject headings, including acoustics and shock, light, energy sources, superconductors, corrosion, area treatments, plastics, lubrication methods, fire fighting, and batteries. Articles of general interest and technical news reports are also announced.

E.P.V.

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—NATIONAL AERONAUTICS AND SPACE ACT OF 1958

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CONTRACTOR REPORTS: Technical information generated in connection with a NASA contract or grant and released under NASA auspices.

TECHNICAL TRANSLATIONS: Information published in a foreign language considered to merit NASA distribution in English.

TECHNICAL REPRINTS: Information derived from NASA activities and initially published in the form of journal articles.

SPECIAL PUBLICATIONS: Information derived from or of value to NASA activities but not necessarily reporting the results of individual NASA-programmed scientific efforts. Publications include conference proceedings, monographs, data compilations, handbooks, sourcebooks, and special bibliographies.

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